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LOCAL GOVERNMENT IN BRITAIN

MORE than three years have now passed since the appearance of the White Paper of the Coalition Government on the reform of local government, and in presenting its second annual report the Local Government Boundary Commission, set up as a result of the sole recommendation of the 1945 report, has now reached the conclusion that in many areas of Britain—and these covering the great bulk of the population—the present powers and instructions of the Commission do not permit the formation of local government units as effective and convenient as they should be. In this report the Commission has chosen to set out its views and to detail recommendations which, if accepted, will require legislation and amendment of the 'General Principles' laid down by Parliament for its guidance. Much of the report is occupied by a discussion of the functions of local authorities, although the Commission has no jurisdiction in this aspect. Its experience has demonstrated the futility of considering functions and boundaries separately, just as it has shown the weakness of the original White Paper in refusing to contemplate any significant change in the existing structure of local government or the introduction of some form of regional development.

The first comment on a report which is characterized by realism and boldness, however strongly the application of some of its principles may be challenged in detail, is one of surprise that such a report could not have been produced in place of the original White Paper more than three years ago. There were then already available reports on local government reform from the Labour Party, the National Association of Local Government Officers and the Liberal Party, as well as numerous proposals from all the main associations of local authorities. The memorandum on local government areas, outlining the problems and opportunities of the Boundary Commission, issued over the signatures of Viscount Astor, Lord Simon and Mr. A. W. S. Burgess, the ex-Lord Mayors of Plymouth, Manchester and Bristol, and also several books which have been published since, ranging from Mr. G. D. H. Cole's "Local and Regional Government" (London: Cassell and Co., Ltd., 1947. Pp. xvi+295. 15*s*. net) to Mr. J. Blackburn's "Local Government Reform: the Two-Tier System" (Altrincham: J. Sherratt and Son, 1947. Pp. 146. 6*s*.), differ rather in the emphasis than in the character of their recommendations. In their analysis of the causes of weaknesses in local government and their criticism of the conditions for adequate reform, they foreshadow very closely the Commission's own recommendations, which might have been equally well forecast from a study of the numerous schemes for the reconstruction of the cities of Britain, or the planning studies of Herefordshire and other counties.

Agreement is now general on the need for far-reaching overhaul, and on the defects of the existing system and their causes; but there is probably less

prospect than in January 1945 of agreement on the nature of the changes required, or of ready acceptance of a scheme agreed by the majority. General reform is now even more likely to be contested hotly, while at the same time the deadlock now threatens the survival, not of the forms, but of the essence and spirit of self-government in local affairs. The multiplication of new public services and duties over the last thirty years and their concentration upon the major authorities to the detriment of the boroughs and district councils, with the tendency to remove altogether from the backward local authorities tasks which reformed authorities could well execute, is sapping the very foundations of local democracy upon which the effective working of democratic institutions upon a national scale depends.

The Boundary Commission's report is first and foremost an indictment of this neglect, of the policy of drift and of allowing piecemeal alteration of the responsibilities of local government authorities to distort the structure, so that it becomes less and less suitable for its task. The Commission has now, as already indicated, rightly decided that local government cannot be properly recast under the piecemeal terms of reference to which it is subject, and in the main the reasons given are endorsed by the large body of evidence already indicated.

At the outset, indeed, the Commission comments on the surprising adaptability of the system as a whole in practice, in spite of the fact that there has been no thorough-going overhaul of local government in Britain since the present system was established in 1888. The strain, however, is heavy, and is increased by various defects such as the disparity between individual counties and individual county boroughs in population and resources. This disparity is due partly to historical causes but mainly to the failure of adjustments of the local government structure to keep pace with changes in either population or functions; and the Commission observes that unless this defect in the system is remedied, Parliament may well hesitate to entrust to local authorities new functions which are in themselves entirely suitable for local administration.

Next, due partly to the weakness of the smaller units in all types of authorities, central control of local administration has increased and, if carried much further, will cut at the root of local government.

The report then reviews the types of local government units, discussing the relative merits of the 'one-tier' system, administered by a county borough council, or 'all-purpose' authority, and the 'two-tier' system, administered by county councils and county district councils. Finally, it recommends the creation of a new type of authority the area of which would form part of the county, but the scope of the functions of which would be intermediate between those of an 'all-purpose' authority and those of a 'minor-purpose' authority.

The broad outlines of the Commission's proposals and the general principles on which they are based have much in common with what has been advanced elsewhere, although most administrative authorities would regard the population limits suggested for the new county boroughs as too low for the autonomous conduct of some of the services, such as education and health, which it is proposed to entrust to them. In the memorandum on local government areas issued by the ex-Lord Mayors of Plymouth, Manchester and Bristol, the principles which it is suggested the Boundary Commission should bear in mind when determining the character of a major authority include the possession by each authority of the minimum standards of population, area and finance for the provision of services on an adequate and economic scale and for the employment of an efficient and specialized staff, and also the value of a satisfactory balance in each area of occupational classes and income groups. Each authority, too, should so far as possible form a satisfactory planning unit and should be based on the area of local political and civic consciousness.

The quantitative result of the Commission's proposals would be the division of England into sixty-seven new counties, none of which would have a population of less than 200,000. Twenty of these would be 'one-tier' counties, that is to say, large towns with precisely the same status as that of a county borough to-day. The remaining new counties would be administered on the two-tier system, with lesser authorities beneath them. The complete picture involves the elimination of seven counties and the insertion of five new two-tier counties, but three-quarters of the existing county boroughs would cease to be all-purpose authorities. On the other hand, there would be created initially sixty-three new county boroughs, authorities for most purposes; and while this may increase the acceptability of the scheme it introduces serious weaknesses and dangers in two-tier county administration. Even the importance of local interest can scarcely balance the reduction of the administrative unit for education and health to one of 60,000, and the attempt to please too many existing authorities, with disregard of administrative opinion, is unlikely entirely to avoid creating fresh jealousy and dissatisfaction between counties and expanding towns.

If this limit of 60,000 were raised to 100,000 or 150,000, a much more confident welcome might have been given to this scheme of reform, although it is still somewhat timid in dealing with the very difficult problems of the provincial conurbations, particularly in the face of such opposed views as those of Manchester or Liverpool and Sheffield or Bradford. It can also be urged further that at the other end the Commission has not faced squarely the real task of securing a more homogeneous lower tier of authorities with responsibilities which will attract the services and interest of the best elements in the local communities. Nor can it be said that the Commission's proposal to create an intermediate type of second-tier authority dealing with most purposes does anything to check the transfer to joint boards or nominated agencies of many functions which are suitable for democratic local control, but which require large administrative units.

It is the invasion, or erosion, of local government in this way that is the gravest danger to-day, and

the great merits of the scheme and the careful study which the report undoubtedly merits should not be allowed to conceal that danger and the urgent need for dealing with it. It would undoubtedly have been better had either the Coalition Government or the present Government the courage and the time to reconstruct local government before the changes introduced by the recent education, health and planning Acts took effect. As it is, disappointment with the Commission's proposals as they affect individual towns or counties, or a possible feeling that the Commission has been excessively devoted to arbitrary standards of size should not be allowed to stand in the way of a careful and objective study of what is a realistic and imaginative plan which calls for action without delay.

The opening chapters of Mr. G. H. D. Cole's book "Local and Regional Government" afford the student much assistance in appraising the Commission's proposals. Mr. Cole is inclined to eschew the intermediate unit, and urges that we need to create and to give real power to both larger and smaller units of administration than have been favoured by the trends of evolution of local government in Britain in recent years. In detail, for all his vision, he is sometimes unrealistic and discards the entities from which transition must be made; but the criticism that may justly be made of his own scheme does not affect the value of his book as a clear and interesting introduction to the problems of local government.

Mr. Cole himself describes his book as an attempt to influence the Boundary Commission in arriving at its plans for recasting local boundaries. It is much more correctly described as an important and valuable contribution to the formation of an intelligent public opinion capable of appraising the Commission's proposals impartially and securing prompt action upon them in so far as they meet the needs of democracy rather than suit the views and prejudices of local councillors and officials. His account of the growth of the existing system of local government is clear and concise, and the various approaches to local government are set out in a way which indicates not only the need for large-scale administrative units for some purposes, but also the immense possibilities in the preservation and recreation of really small communal units for other purposes closely related to the everyday lives of the people. The book is a useful contribution to the understanding of all the factors that are involved in the 'new towns' policy of the Government as well as of those that affect local government itself. It points to positive ways in which the community spirit might be revived and encouraged, and while giving a clear idea of what regionalism is, the different approaches to it and the dangers to be avoided, it should stimulate constructive and independent thinking about the nature of such authorities as well as of the technical and national boards dealing with water supply, power, transport and the like. Although, as already noted, the treatment of the problems of the great provincial cities or conurbations is not entirely adequate, at least the principles are indicated which could form the basis of more fundamental thinking about those problems.

Two of those main considerations emphasized by Mr. Cole are the immediate concern of scientific and technical workers and their professional associations. Recent debates on the Water Bill and the River Boards Bill have shown how technical development continues to call for the conduct of a number of essential public services under unified management over large areas. Water supply and drainage, sewage disposal, the control or prevention of flooding and pollution, fisheries, power supply and transport all present problems which may on occasion make impracticable for particular services the reconciliation of technical requirements with the adoption of areas of management that are suitable for other purposes of regional or local government. The tendency may be unavoidable, but Mr. Cole's book should help the technician concerned to keep aware of the dangers inherent in such unification, and of the desirability of keeping it to the minimum consistent with genuine technical requirements.

Other services, such as gas and health and consultant services, may require to be co-ordinated and planned, but not administered, nationally; and it has already become apparent how much a professional body can contribute towards the solution of the problems involved in regional and local administration when national standards of service are to be observed and professional ideals and traditions maintained.

Primarily, the scientific and the technical worker is concerned with technical aspects of the problems which arise in local or in national government, and with seeing that technical requirements of efficiency are met. While, however, they must not be deflected from an impartial appraisal of the technical requirements by professional bias or sectional prejudice, they must be imaginatively alive to the human problems of government no less than to what is administratively practical. Something more than technical or professional competence is needed to resolve the deadlock in local government. Doubtless in time the British Institute of Management may be able to make its own contribution to the clear thinking that is essential, and especially by assisting in applying the lessons learnt under the stress of war in civil defence, the community centre and like fields.

Fundamentally, however, the second report of the Local Government Boundary Commission touches the scientific worker not so much because of its relation to special fields of professional responsibility but for its challenge to the constructive forces of democracy. On our response to that challenge now the future of local government and even of democratic government in Britain may well depend. The problem of relating knowledge and action in ways which satisfy both the technical need for planning over wider areas and the democratic need for execution of the plans by far smaller communities in which the personal touch, local knowledge and patriotism can play their vitalizing part, is an old one. Goodwill and active support of every scientific worker will be required, individually, through his professional associations, and perhaps not least in assisting the universities to recognize and discharge their regional responsibilities.

E. S. BEAVEN, A GREAT BARLEY EXPERT

Barley

Fifty Years of Observation and Experiment. By Dr. E. S. Beaven. Pp. xx + 394 + 27 plates. (London: Gerald Duckworth and Co., Ltd., 1947.) 30*s*. net.

IT is difficult to convey to this generation any adequate impression of the giant personalities that gave the Victorian era such brilliance and distinction. E. S. Beaven was one of them. Barley was his great life interest: he was the son of a barley grower, and son-in-law of a maltster whose business he entered as a youth; all his life was spent in handling barley and he knew it more intimately than any of his generation or this. But it was not only as a barley expert that he was known and respected: he was typical of his time, a sturdy, vigorous, forceful personality, outspoken, scathing in his denunciation of anything State-aided or other spoon-feeding agency; a stout believer in self-help, in some of his contemporaries, and in himself.

Beaven entered his father-in-law's business in 1878 when the malting barley most commonly grown was probably 'Chevalier', a variety accidentally discovered by a farm worker John Andrews at Debenham, Suffolk, and multiplied by his landlord, the Rev. J. B. Chevallier, after whom it was named—an 'l', however, being dropped during the process. This barley is of excellent malting quality, but it has some disadvantages: its straw is liable to be weak, and its neck, that is, the part between the uppermost node and the ear, is long and liable to bend over as the ear gathers weight; it becomes brittle during the desiccation accompanying maturation, and is liable to break so that the ears are lost.

There were, however, numerous other sorts in cultivation, including 'Archer', an old English variety of unknown origin, characterized by rather late ripening, a short neck, rather grey-coloured grain, better yielding capacity than 'Chevalier' but of lower malting quality; and 'Spratt', described in Lisle's "Essays on Husbandry" (1757), which, however, was grown only locally, chiefly in a few scattered districts in the Fens and in Essex: it had very stiff straw, could stand up where many other sorts would 'lodge', and was capable of high yields. In Beaven's youth another variety came into general use: 'Goldthorpe', raised from a single ear found by Mr. Dyson of Goldthorpe, Yorks, in 1889 in a field of 'Chevalier' barley. This was a considerable improvement on the existing sorts, and the fact of its discovery and its spread made a deep impression on him.

Beaven knew also of the Danish experiments on barley begun in 1882, and was much impressed by the valuable results yielded by the variety trials made there between 1893 and 1902. He began field experiments at Warminster in 1895, starting with single-plant cultures of various established races of barley and gradually expanding his programme. Then in 1902, in order to cope with the disconcerting depredations of birds, he erected a large bird-proof wire structure (later enlarged) under which special cultures could be grown. In all, his experimental ground finally covered about four acres.

Large numbers of single-line cultures were made, and those that came out best were further tested on a larger scale at Warminster and Cambridge; two soon came into general cultivation: 'Plumage' (of Danish origin) and 'English Archer'. He quickly realized the limitations of the selection method; while it furnished strains of higher yielding capacity, it could not introduce any new characters. So with the active help of R. H. Biffen and T. B. Wood (who became his son-in-law) he commenced hybridization in his cage, discarding unsuitable plants from the F_2 generation onwards, but carrying on the most promising to the F_3 generation. The surviving sorts were then transferred to small plots, replicated but not randomized—this refinement had not yet been introduced and in any event Beaven did not approve of it; the final selections were then multiplied up and compared with the standard sorts in the field, the seed being sown in a drill divided into two halves, so that two sorts could be sown in alternate half strips. His first great triumph was the production of 'Plumage–Archer', which speedily became very popular among farmers; but others of his productions achieved considerable fame, and undoubtedly his labours contributed largely to the marked increase in yield of barley that has occurred since 1900. No one in Great Britain has done so much and so well for barley as he.

Beaven's success was due to his amazing gift for recognizing the qualities of barley. He knew by some intuitive process which of his many seedlings to reject and which to retain. He combined the artist's eye and the scientist's recognition of the need for full and accurate records, though he always disclaimed any scientific merit.

It was well known that he had accumulated large numbers of data, but during his active life he could never be persuaded to work them up: it was, indeed, feared that they might be lost. Fortunately he did in the end summarize his results; and although he has not lived to see the book, the devoted labours of Miss N. Stallwood have ensured its completion. To her is owed a great debt of gratitude, for it would have been a tragedy had the records remained unavailable to later workers.

Work of this sort is not likely to be done in the future, for the day of the non-professional scientific worker is past: no one now has the necessary means. Yet it must be admitted that some of the greatest advances in agriculture, as indeed in other subjects, have been made by non-professional workers combining the scientist's skill in ascertaining facts with the artist's perception of what lies behind them—often seeing further than the facts seem to warrant. It still remains to be seen how far the organised labours of teams of trained workers can go in achieving comparable results.

E. JOHN RUSSELL

ELEMENTARY PHYSIOLOGY

Introduction to Physiology

By Prof. W. H. Newton. Pp. 284. (London: Edward Arnold and Co., 1948.) 7*s*. 6*d*. net.

PHYSIOLOGY is a subject covering such a wide range of interests, and involving so many other branches of science, that teachers of it tend to have their own individual ways of approach. Most of them, after trying various ways of introduction to the subject, end up by considering, first, what that great teacher of physiology, Sir Michael Foster, called the 'master tissues' of the body, the muscles and the nerves. Prof. W. H. Newton, when he comes to deal with the different systems, also adopts this order; but his approach is refreshingly individual. He begins

with an interesting chapter on "The Fire of Life" and passes on to a study of the control of temperature in the body, before he deals with the nerves, from the double aspect of the mechanism of nervous activity and organisation of the nervous system, and with the muscles, which he considers from a wide point of view under the heading 'movement'.

Throughout the book there are evidences of wide teaching experience in the shape of simple illustrations and analogies. In the main these are useful, though occasionally some of the drawings seem so simplified as to be unnecessary and the analogies to be unduly strained. The early chapters, interesting and unusual as they are in their presentation in a book of this kind, are likely to be hard reading for the ordinary lay person, though admirable for students of physiology whether working in the medical or science faculties.

As, however, nearly one-third of the book is devoted to these introductory chapters, the rest of the body has to be less fully considered; though here again valuable and less usual aspects of the systems are stressed. There are, for example, good sections on the factors controlling the circulation in different organs, on the functions of the kidney, short but excellent paragraphs on integration, and instructive maps showing the relationship between the amount of iodine in water supplies and the incidence of goitre as shown by the Army recruiting figures from the United States.

Altogether the book provides an interesting and thought-provoking introduction to a subject of much practical importance, and is one which should help those for whom knowledge of physiology forms a part of their training to a realization of its fascination.

W. C. Cullis

FUNDAMENTALS OF HEAT ENGINES

Elements of Applied Energy

By Prof. Frederick T. Morse. Pp. ix+444. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1947.) 30*s*. net.

THIS book, by the professor of mechanical engineering at the University of Virginia, may best be described as an up-to-date heat engines text-book of an essentially descriptive character. It is intended as an introduction to heat power for second-year students, to show them "the how and why of machines and other equipment in which energy plays a part". As such, it should fulfil its purpose admirably, the subject-matter being presented and illustrated in a manner which makes its reading particularly easy and agreeable.

It makes no claim to deal with the underlying theory, the mathematics being limited to occasional formulæ inserted in the text, and presented without proof. The limitations imposed by this method of presentation inevitably lead to occasional difficulties, which on the whole are successfully overcome; but it is disappointing to find such inaccuracies and over-simplifications as "hence isentropic process is a synonymous expression" (for adiabatic process); or "in the reaction turbine the nozzles are themselves attached to the shaft", even though these statements be qualified later in the text.

The extent to which this book brings its subject up to date may be judged by the fact that sections are included on atomic energy, gas turbines, jet engines and the war-time rockets and flying bombs. These sections form a small proportion of the 435 pages, the greater part being devoted to a modern presentation of the subjects commonly met with in a heat engines text-book such as this. Useful tables of the properties of steam and other fluids are included in a supplement.

In general, the book might best be described as suitable for higher national certificate courses in Britain, though this does not mean that the book is unsuitable for courses leading to an honours degree; its agreeable manner of presentation makes it very suitable for spare-time reading by the honours student, to provide him with the necessary practical background to his more theoretical studies, and in that way to stimulate his interest.

R. W. Haywood

ELEMENTARY THEORY OF ELECTRICITY AND MAGNETISM

Electricity, Magnetism and Modern Physics

A Textbook for the use of Scholarship Candidates and University Students. By Dr. G. T. P. Tarrant. (Being Vol. 2 of Physics.) (Dent's Modern Science Series.) Pp. xii+468. (London: J. M. Dent and Sons, Ltd., 1948.) 15*s*.

THE author states in his preface that this book is intended for students of physics who have placed the higher school certificate examination behind them and are proceeding to university scholarships or degrees, and there is no doubt that he has succeeded in producing one ideally suited for them. Much care and thought have obviously been given to the elucidation of the more difficult points in the theory of electricity and magnetism which are so often passed over in silence. The opening synopses of the histories of electricity and magnetism are likely to be very helpful to those students who might otherwise be worried by our modern conventions and order of presentation of the subjects.

The author is particularly sound in his discussion of dimensions, although the reviewer prefers to take ϵ as a fundamental quantity in these modern days. The mathematical portions of the book are set out fully and in a manner which the average student should find easy to follow, and there are tables of practical importance, such as that of magnetic quantities on p. 278, which are very valuable in a book of this kind.

About three-fifths of the book are devoted to what is usually termed modern physics, and of which there is a survey fully adequate for the pass or general degree student. There are one or two small blemishes in the chapter on the theory of magnetism; for example, it is desirable always to emphasize that it is the magnetization vector of a domain which rotates, and this is best done by inserting the word vector wherever possible. Again, the figure on p. 284 and the use of italics on p. 286 may give the impression that Bitter figures are formed only upon a surface to which an applied magnetic field is perpendicular. Most teachers will appreciate the clear and helpful diagram which illustrates Dunnington's (not Duddington) method for finding e/m; but the inclusion of an electron path in the Bainbridge mass spectrograph may put dangerous ideas into students' heads. But these suggestions should not be taken to detract from a book which is warmly welcomed.

L. F. Bates

Our Inner Conflicts

A Constructive Theory of Neurosis. By Dr. Karen Horney. Pp. 250. (London: Kegan Paul and Co., Ltd., 1946.) 10*s*. 6*d*. net.

MANY attempts have been made to modify the original Freudian technique and theories regarding the origin and treatment of neurosis. This book describes the variations which Dr. Horney has developed and gives an outline of her views on psychology, which are interesting and coherent. The first thing which strikes the reader is that the analyses she records are not transference analyses in the Freudian sense at all and, in fact, the word 'transference' does not appear in the index. She does not believe, with Freud, that neuroses are caused by some distortion of the instinct but that they are the product of abnormal personality. She thinks that anxiety is produced by isolation, for example, and not by castration fears or birth trauma; that obsessions are due to disturbed personal relationships and not to repressed sadistic impulses, and so on. Her views on personality are individual also. She believes that there are three types: (1) compliant, (2) aggressive, (3) detached. They are really devices to deal with the patient's basic anxiety. This anxiety is also avoided by idealization of the ego, so that the patient is able to see himself as more perfect than he really is. The neurotic conflicts, she thinks, often lead to diversion of energy from useful channels, so that there is an impoverishment and inertia, the final stages of which are an all-pervading feeling of hopelessness.

Dr. Horney's psychology is half-way between that of Freud and Adler. She has a moralistic approach and her analytical technique is purely interpretative, but her views are based on clinical work and will be of interest to the psychotherapist, particularly those with Adlerian inclinations. CLIFFORD ALLEN

Practical Physiological Chemistry

By Dr. Philip B. Hawk, Dr. Bernard L. Oser and Dr. William H. Summerson. Twelfth edition. Pp. xiv+1323. (London: J. and A. Churchill, Ltd., 1947.) 50*s*.

THE rapidity with which advances are made in our knowledge of biochemistry and the fields of study with which it shares common ground makes the frequent revision of text-books dealing with these subjects a real necessity. It is ten years since the publication of the eleventh edition of Hawk's "Practical Physiological Chemistry", so that the appearance of a new edition is both timely and welcome. In the forty years since its first publication, this text-book has achieved a position which is probably unique. It is of value to teachers, research workers and routine analysts alike, the treatment of most aspects of the subject being both theoretical and practical and the scope of the experimental sections the widest possible.

The extensive additions and revision which have now been made will undoubtedly greatly increase its value to all its users. The changes embodied in the new edition are too many to mention in detail; but the following are some of the more considerable ones. A new chapter has been added, dealing with antibiotics, including penicillin, gramicidin, tyrocidine and streptomycin, and with metabolic antagonists, including analogues of vitamins and amino-acids. The chapter on enzymes has a new section concerned with cellular respiration, in which the Warburg manometric technique is described. The section on colorimetry has been extended to include a detailed account of various types of photometric technique. Other recently developed experimental techniques which are now discussed are microbiological assay of vitamins and amino-acids, polarography, use of isotopes and electrophoresis.

The chapters on hormones and vitamins have been extended to cover the enormous developments which have taken place since 1937, considerable attention being paid to the estimation of vitamins: it is in these sections more than in any others that the extent of the progress made in the last decade is apparent. Several new appendixes have been added, including one dealing with the analysis of variance, and a new feature is the inclusion in each chapter of a bibliography of relevant recent publications. These additions and many others have necessitated a considerable increase in the size of the book, which is, however, still very clearly printed and well indexed. In summary, it may be said that the new edition should ensure the maintenance by this book of its well-deserved popularity.

My Caves

By Norbert Casteret. Translated by R. L. G. Irving. Pp. xi+172+16 plates. (London: J. M. Dent and Sons, Ltd., 1947.) 15*s*. net.

THIS is a book which the general reader will enjoy and find exciting as well as informative. M. Casteret, well known already for his earlier study, "Ten Years under the Earth", has written it "not . . . as a technician, but as a dilettante", and in taking the reader "on a pleasure outing in the cave-country" he writes vividly of his experiences in pot-holing, in "reptation" and in the patient observation of the habits of bats. He devotes a chapter to each of these activities, and deals also with the purpose of spelæology and the equipment needed for its pursuit. He displays, as well as considerable courage, a sense of humour and an æsthetic, indeed almost mystical, appreciation of the wonders of the under-world. He writes with respect of the pioneers of cave exploration and marvels at the Palæolithic troglodytes. Enough is said of the value of spelæology to the geophysicist, the botanist and the hydro-electric engineer to show that it is more than a sport, though the appetite for scientific knowledge is no more than whetted.

The photographs, some taken underground by M. Casteret himself, are interesting and varied, and the translation is good and reads quite naturally, although English equivalents for some French technical terms had to be devised.

An Introduction to Filmstrips

By H. R. and I. W. Dance. Pp. 36. (London: George G. Harrap and Co., Ltd., 1948.) 2*s*. 6*d*. net.

THIS pamphlet contains a deal of common sense in a short space. Written with the needs of the classroom teacher firmly in mind, the technical processes of filmstrip production, the pros and cons of different types of apparatus and the basic principles involved in the use of this form of teaching aid are dealt with succinctly, lucidly and objectively. The line drawings and half-tone illustrations which accompany the text where necessary are admirably chosen for their purpose. On the most controversial point dealt with, the choice of frame size, the authors present a strongly argued case in favour of double-frame strip (24 mm. × 36 mm.) for general purposes,

while agreeing that in certain instances single-frame strip (18 mm. × 24 mm.) will continue to be used.

There is still a tendency in many quarters to regard cinematograph film as almost the only form of visual aid worth mentioning. Ciné-film will always play an important part in education, but for regular classroom use the more humble filmstrip has much to commend it. The apparatus required is compact, weighs little and is easy to operate. The medium can be adapted to most classroom needs, is economical of time and allows considerable control of material by the user. Further, at very moderate cost the teacher can try out his own ideas in the way of filmstrip production—and will learn much in the process. Users of filmstrip, whether or not they are interested in amateur production, will find the practical suggestions in this little book helpful and stimulating without being dogmatic. ERIC LOWE

The Artificial Insemination of Farm Animals

By John W. Bartlett, George E. Taylor, Joseph Edwards, Clair E. Terrill, Victor Berliner and Fred P. Jeffrey. Enos J. Perry, Editor. Pp. v+265. (London: Chapman and Hall, Ltd., 1947.) 15*s.* net.

THIS book originally appeared in the United States in 1945. Since then much practical experience has been gained in the application of artificial insemination, both in the United States, where some million and a half cows are by now being registered annually for insemination, and in Britain, where a network of insemination centres will soon cover the country. Research work stimulated by this rapid advance has also made considerable progress, and improvements in method are continually being adopted. Quite new problems are arising. Although in consequence of this rapid advance this English edition is in many respects already out of date, it is still the most comprehensive work on the subject in the English language, and will prove very useful as a general introduction for the student of agriculture and veterinary science and for the farmer who takes an interest in the advance of scientific method. To the specialist it will be rather less useful. The treatment is on broad general lines, and exact quantitative data are not usually given to support the arguments. The chapters which describe the technical aspects are the most important. The ones which deal with the genetical aspects of livestock improvement are of less value. ARTHUR WALTON

Forest Valuation

With Special Emphasis on Basic Economic Principles. By Prof. Herman H. Chapman and Prof. Walter H. Meyer. (American Forestry Series.) Pp. xii+521. (New York and London: McGraw-Hill Book Co., Inc., 1947.) 36*s.*

THIS book represents the development of earlier work on valuation and finance by Prof. Chapman of Yale. The wide scope of the applied part can be inferred from the main contents: the evaluation of real property producing annual income; present worth of forests producing periodic income; costs of production versus profits and the role of compound interest; rates earned and the profit margin; rotations; taxation; damages; fire insurance; methods of appraisal of stumpage value; determination and application of conversion returns; and the appraisal of forestry purchases for future operations. Appropriate formulæ, mainly concerned with compound interest and discount, are provided for the many and various problems which arise in forest finance. The importance of discount as applied to future net income in determining the present worth of an enterprise is stressed. Market values have limitations, and confusion in the past has been caused by the limitations in the use of compound interest. The authors hope that their treatment marks the final departure from the original European sources of forest evaluation and statics as set forth in Schlich's "Manual of Forestry". Many of the problems illustrated in the book are therefore specifically North American, although the principles outlined have wide applicability.

Teachers of applied economics will be interested to note the emphasis on the great advantage to students of a grounding in economic theory. The first six chapters have this need in mind, and the hope is that by stressing these principles in their direct relation to forest economics and valuation, the subject has been vitalized and its importance made clear to professional foresters and to owners and operators of forest property. J. J. MACGREGOR

Le forze creatrici dell'uovo

Questioni moderne d'embriologia. Per Prof. Pasquale Pasquini. (Sapienza, Vol. 3.) Pp. 334. (Pisa and Rome: Libreria Vallerini, 1948.) 700 lire.

PROF. P. PASQUINI has provided Italian readers with a clear and well-illustrated introduction to modern experimental embryology. He opens with a historical chapter, in which the seventeenth-century controversy between epigenesis and preformation gives him an opportunity to define the fundamental problems. The next chapter, on the maturation of the gametes, gives a good, if elementary, account of the cytoplasmic organisation of the ovum; but, as so often in embryological works, is old-fashioned in its treatment of meiosis. After these preliminaries, we come on to experimental embryology proper. Although there is nothing very original in the author's treatment, he covers the ground adequately, bringing his book right up to date by accounts of such new developments as Holtfreter's studies on the mechanism of gastrulation and the various theories of organiser action. The Italians are fortunate in having such a text-book for university students in their early years; there is nothing similar available in Great Britain. C. H. W.

Bird Recognition

1: Sea-Birds and Waders. By James Fisher. (Pelican Books, A.175.) Pp. 190. (Harmondsworth and New York: Penguin Books, Ltd., 1947.) 2*s.* 6*d.*

ALL too often the elaborate descriptions of birds that give each detail of plumage with minute exactitude are not much help to recognition in the field. Mr. James Fisher, in a 'Pelican' devoted to sea-birds and waders, and entitled "Bird Recognition", writes not with one eye but with both eyes on the field worker, and the novice at that. All persons interested in ornithology will find this little volume helpful but no one more so than the beginner, who will find it a valuable aid to the identification of the many species of waders and gulls to be found on and near the sea. The illustrations consist of monochrome portrait sketches by "Fish-hawk", maps chiefly by Mr. W. B. Alexander, and diagrams, consisting of circular calendars, showing the distribution of the species throughout the twelve months. Much information is thus packed into a small space and a useful, helpful book results.

FRANCES PITT

THE GAS INDUSTRY IN BRITAIN*

By Dr. E. V. EVANS, O.B.E.
South Metropolitan Gas Company

COAL is the foundation of Great Britain's power of survival, and the gas industry is one of the instruments which the people of this country have created to use coal to the best advantage. In other lands oil and water power may take the place of coal, but Britain has neither oil nor any substantial quantity of potential water power. The liberation of energy by the fission of certain kinds of atomic nuclei has led to a great deal of speculation, but in the present state of knowledge we have no warrant to assume that this achievement represents unlimited supplies of exceedingly cheap power. Coal is likely to remain the staple fuel of Britain for very many years to come, and it is a matter of gratification to observe that during the last decade the nation has come to realize the importance of conserving its coal resources.

It is now generally realized that, if used wisely, every ton of coal can do much more work in industry and provide higher standards of comfort and cleanliness in the home.

The British gas industry treats annually about twenty-two million tons of coal and employs directly some 130,000 persons for the purpose of rendering a public service. It provides fuel in the form of gas, of coke and, to a relatively small extent, as oil fuel. With the other great fuel and power industries of coal, electricity and oil, it strives in healthy competition to serve industry and the public as effectively as possible, and it would be unfortunate if, as a result of the nationalization of the fuel industries, the healthy competition which has in the past been an incentive to progress ceased to exist. On the other hand, it would show great wisdom and prudence if the administrators of the future were to allot to each fuel industry those services which in the national interests it should best perform.

The basic processes which are operated to convert coal into gas fall into the two groups of carbonization and gasification.

Carbonization consists essentially in roasting the coal with the exclusion of air, the heat causing the coal substances to decompose with the evolution of gas and tar. Coal consists mainly of compounds of the elements carbon, hydrogen and oxygen, in such forms that the greater part of the carbon in the original coal remains behind in the carbonizing vessel as coke. This coke is carefully prepared for use in industry and in the home, or it may be used in the gas works for the production of gas by processes of gasification, employing the reactions which take place between incandescent coke and air or steam to manufacture either producer gas or water gas.

A modern works carbonizing coal for the production of gas operates with high thermal efficiency, recovering as much as 85 per cent of the heat potentially available in the coal in the form of gas, coke and other products.

Forty years ago, gas making was an art, full of tricks and intricacies learned by constant practice and enriched by ingenuity; but the gas engineer of that time understood little of the nature of the processes he was conducting. To-day the chemist and physicist have placed these processes upon a scientific basis. In those earlier days what we now know as consumer service was a relatively simple matter. The responsibilities of the gas engineer and manager of to-day are quite different. In order that the processes of a gas undertaking may be operated efficiently and the service to the public equally efficient and reliable, the industry has built up a complex organisation with specialist sections.

The gas-holder, so familiar that it is a symbol of the gas industry, is an appliance of the utmost importance. Without gas-holders the productive capacity of the gas-making plant of Britain would have to be about five times as large as it is at present to permit the peak demands to be met. During the midday cooking period on a Sunday, the demand may be five times the average over the whole day, while at midnight the demand may fall to about one quarter of the average. The gas-holder permits these wide changes in requirements to be met, while the manufacturing process continues to operate at a uniformly steady rate throughout the twenty-four hours.

Over the last sixty years the output of gas has grown steadily year by year at an almost constant rate, although at the present time the rate of growth is about twice the average rate over that period.

There are in Great Britain about twelve million families, and as nine out of every ten already use gas it follows that the industry cannot look forward to any large increase in the number of customers. This, however, does not mean that it cannot look forward to any further increase in sales and, indeed, the present abnormally high rate of increase is taking place with almost no change in the total number of users. What is happening is that gas is being used for more and more purposes.

Although the original purpose of public gas supply was to provide artificial illumination, gas lighting represents to-day only about five per cent of the total gas sales. About one half of all the gas sold is consumed by domestic users for cooking, and these same families use a further fifteen per cent of the total for other domestic services, such as water heating, the heating of rooms, the washing and drying of clothes, and refrigeration for food storage. The quantity of heat required for these other purposes, if they are to be performed adequately, is much larger than that required for cooking, and in this fact lies the great scope for the further use of gas in the home. Commercial consumers take about twelve per cent of the total sales, and some eighteen to twenty per cent goes to industry.

The industry has in recent years given attention to the formulation of tariffs which, as nearly as may be, relate the price charged to the actual cost of supply, and it is interesting to record that domestic consumers of one large undertaking who have adopted a two-part tariff system of charge have practically doubled the quantity of gas previously used by them.

The basis of the industry's service is a scientific understanding of the principles involved. This applies not only to the manufacture and utilization of gas but also to the manufacture, preparation and utilization of such by-products as coke and tar.

Coke is to-day a carefully prepared smokeless solid fuel for which a variety of highly efficient appliances have been designed, many of them with gas ignition. For the long-period heating of rooms and for the provision of hot water in the winter months, coke is playing an important part in the efficient use of coal and the abolition of smoke.

The largest use of tar is as a waterproof binder for holding together the stone aggregate of road surfaces,

* Substance of a Discourse to the Royal Institution delivered on April 16.

and here a study of physical properties and methods of application has enabled the science of road construction to keep pace with the increasing severity of the demands made by traffic.

The application of science to a practical problem may be illustrated by reference to the provision of comfortable warmth in the living-room of a dwelling house. The gas fire of the past was noisy, the fireclay elements were fragile and the sensation of heat was more often one of scorching than of comfort. The continuous noise of the fire when in use arose from the aerated flame burner in which the gas and air were mixed together before they reached the point of ignition. Much was done by studying the aerodynamics of the system to reduce the noise; but complete silence in operation was not achieved until the adoption of the non-aerated burner. These burners were not in themselves novel; but, so long as gas was sold for the intrinsic luminosity of its flame, the non-aerated type of burner could not be relied upon for heating purposes because of its liability to deposit soot. To-day, when gas is sold on its heating value and mainly for heating purposes, the rich hydrocarbons—benzene and its homologues—are recovered as motor benzole. This makes an important contribution to our supplies of motor spirit and at the same time produces a gas which can be burned in a non-aerated burner without risk of sooting.

The purpose of the fireclay element in a gas fire is to receive heat from the flame, being thereby raised to incandescence and emitting this heat by radiation. It was the practice to suspend the fireclay elements in the flame itself and if they were quickly to reach incandescence they had to be light, of small cross-section, and in consequence necessarily fragile. The difficulty was overcome by developing the observation that if gas flames are confined in a fireclay box and one wall of this box is perforated or slotted to a limited extent, the internal surfaces become incandescent and shine out through the slots or perforations. As the purpose of the perforated wall is to restrain the heat from escaping too rapidly, it can be made of robust material and the problem of fragility is overcome. The perforated fret has the further advantage that the apertures can be so arranged as to alter the geometrical distribution of the radiant heat, a matter of importance in the production of comfortable heating.

The study of heat comfort has revealed the necessity of providing such a degree of background heating that the temperature of the air, walls and furniture does not fall below 55° F., and ensuring that the radiant heat employed to supplement the background heating is emitted in a broad beam shining upwards and outwards. With these requirements satisfied a gas fire produces comfortable conditions within a few minutes of lighting and, what is more, the occupants of the room may sit in comfort around the fire for any length of time. The recognition of these requirements has led to the development of the convector gas fire which, in addition to providing the radiant heat, also recovers from the flue gases heat which is employed to warm the air of the room.

The application of scientific principles, of which the foregoing example is but one, has brought us to-day to the knowledge that greatly improved standards of comfort and hygiene may be provided with less consumption of fuel. The unsatisfactory standards of the past have involved the use of five to six tons of coal by a household each year. By employing gas and coke for cooking, water heating and space heating, and electricity for lighting and power, coal is saved and living conditions improved.

The gas industry has great potentialities for further development and goes forward into the future with pride in its past traditions, skill in its present technique, and confidence in its ability to play a large part in restoring the fortunes of Great Britain.

CHROMATOGRAPHICAL STUDY OF MERISTEMATIC PLANT TISSUES

By Dr. A. ALLSOPP

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RECENT years have seen a revival of interest in the apical meristems of plants, but little has been done on the metabolism of these regions. The lack of suitable methods for dealing with small amounts of tissue may be held accountable for this state of affairs; but the development of paper partition chromatography seems likely to provide a method of first-class importance in metabolic studies of apical meristems, or indeed of any other tissues which are available only in restricted quantity.

Paper chromatography was first described in detail in 1944 by Consden, Gordon and Martin[1] as a method for the qualitative analysis of proteins. The same workers[2] have recently adapted it to the identification of lower peptides, while others have developed the technique for the qualitative[3,4] and quantitative[5,6] analysis of sugars. The quantitative analysis of amino-acids has also been reported in outline[7,8]. Lugg and Overell[9] have described a quantitative method for organic acids, while Crammer[10] has used paper chromatography in the separation of flavine nucleotides. Further developments may be anticipated; but the existing methods already provide valuable equipment for the investigation of plant materials.

The only work yet published which deals with a systematic examination of a plant tissue by paper chromatography is that of Dent, Stepka and Steward[11], who investigated extracts of the soluble nitrogen of disks of potato tissue. In the work outlined in the present communication, examination was made of the amino-acids contained in cold 70 per cent alcohol extracts and in acid hydrolysates of the residues of various plant tissues. The solvents used in the chromatography and other details of technique were similar to those described by Dent, Stepka and Steward[11].

The initial object of this investigation was the study of the amino-acids, free and combined, of apical growing points; but as the work progressed it was considered desirable to provide a basis of comparison by examining a range of materials from some of the principal taxonomic groups of plants. The following materials were examined: thallus of *Gigartina stellata* (Rhodophyceæ); old thallus and young branches of *Conocephalum conicum* (Hepaticæ); shoot of *Polytrichum commune* (Musci); developing synangia and mature stem of *Psilotum triquetrum* (Psilophytinæ); leaf of *Isoetes echinospora* and stem of *Lycopodium Selago* (Lycopodinæ); apices of aerial shoots, nodal tissue and young induced lateral branches of *Equisetum giganteum* and prothalli of

Equisetum arvense (Equisetinæ); shoot and root apices and central tissue of root-stock of *Dryopteris aristata*, prothallus of *Osmunda regalis*, and prothallus and leaf of *Angiopteris evecta* (Filicinæ); buds of *Ginkgo biloba* and young branches of *Ephedra altissima* (Gymnospermæ); and flower buds and mature stem of *Cheiranthus Cheiri* (Angiospermæ).

Analyses of root tips of *Dryopteris* were based on the terminal 3 mm. from seventy-six roots giving a total fresh weight of 0·057 gm. The meristematic tissue of the shoot was obtained from three well-grown stocks. After removal of scales and leaf primordia a cylinder of tissue carrying the apical cone was obtained by driving a cork borer vertically through the stock. A razor was then used to cut off a thin disk of meristematic tissue bearing the apical meristem and minute leaf primordia only. The combined fresh weight of the three disks was 0·032 gm. Growing-points of *Equisetum giganteum* were exposed by removing the sheathing leaves, and the terminal 2 mm. from a number of shoots were combined to give a total fresh weight of 0·05 gm. The single prothallus of *Angiopteris* was 0·151 gm. and a portion of a large prothallus of *Osmunda* of fresh weight 0·172 gm. was used. Similar amounts were used of the other tissues examined.

The tissues were weighed into small stoppered ignition tubes and crushed with sufficient 90 per cent alcohol to give a final concentration of 70 per cent. The extracts were removed by centrifuging, and extraction was repeated with 70 per cent alcohol (five to six times in all). Several volumes of 6 *N* hydrochloric acid were mixed with the residues and, after sealing, the tubes were placed in an oven at 100° C. for 20–24 hr. After cutting open the tubes, while wearing goggles, the insoluble residue was removed by centrifuging. Extracts and hydrolysates were evaporated to dryness under reduced pressure without heating. The product was redissolved in a small quantity of water (0·10 c.c. or less) and aliquots taken for chromatography. Usually one-tenth of the sample was used for one-dimensional chromatography, with phenol as solvent, as an indicator of the amount required for two-dimensional chromatography. Two-fifths of the extract was usually suitable for the latter.

In these small amounts of apical tissue, the protein content was sufficiently high to yield good chromatograms from the acid hydrolysates. Thus the following amino-acids were identified in hydrolysates of the shoot apex of *Dryopteris*: aspartic acid, glutamic acid, glycine, serine, threonine, alanine, arginine, lysine, proline, valine, methionine, leucine, phenyl alanine and tyrosine. Tryptophane is destroyed under the conditions of hydrolysis, while cystine and histidine do not yield well-marked spots under the conditions and concentrations utilized. Hydrolysates of the root apices and of tissue from the middle of the root-stock yielded chromatograms showing the same amino-acids, with no evident difference in their proportions, although the total amount was several times greater in the stem apex than in an equal fresh weight of the central tissue of the stock. The same amino-acids were obtained from *Equisetum* shoot apices and from nodal tissue of the same plant.

The free amino-acids, extracted from the apices by 70 per cent alcohol in both *Dryopteris* and *Equisetum*, formed only a small fraction of those liberated from the tissues by acid hydrolysis. In the *Equisetum* apex only glutamic acid and aspartic acid were found. In root and shoot apices of *Dryopteris*, glutamic acid was most prominent with aspartic acid also present in appreciable quantities. Glutamine was present in the root tips, but was not detected in the shoot apices, although tissues immediately behind the apex contained moderate amounts. Faint tyrosine spots were obtained from both root and shoot apices but were more prominent in the former. In both cases the chromatograms showed a well-marked spot in the leucine position. Methionine and *iso*leucine occupy the same position with the solvents used for the two-dimensional chromatography, but a one-dimensional chromatogram using 1 : 1 butanol-benzyl alcohol as solvent indicated that this spot was from leucine only. Tissue from the centre of the stock of *Dryopteris* was also relatively low in free amino-acid content, but in this case more acids were present and included aspartic acid, glutamic acid, glutamine, arginine, valine and leucine. It remains to be seen to what extent the free amino-acids are influenced by season and by varying experimental conditions.

Examination of the plant materials listed above has revealed marked differences in the free amino-acid content, and a truly striking correspondence between the chromatograms produced from the acid hydrolysates. Clear chromatograms were obtained from all the plant materials listed with the exception of *Equisetum* prothalli and *Lycopodium* stems, in both of which the protein content of the amount of tissue taken was insufficient for two-dimensional chromatography. In *Lycopodium*, however, it was possible to identify aspartic acid, glutamic acid, serine, valine and leucine. In chromatograms of all the other species the amino-acids already listed for *Dryopteris* were present in every case, with the possible exception of the leucines. In *Isoetes* leaf and *Psilotum* synangia only *iso*leucine was detected; but no hydrolysate remained to test whether this was also characteristic for the shoot tissue of *Psilotum*. Only leucine was detected in all parts of *Dryopteris*, in *Conocephalum* and in the prothallus of *Angiopteris*. Both *iso*leucine and leucine were present in the other materials tested, which included all those listed with the exception of *Angiopteris* leaf, *Equisetum* prothallus and *Lycopodium* and *Cheiranthus* stems. Apart from these differences in the leucines the chromatograms were virtually alike. In addition to the amino-acids named above, the stronger chromatograms showed a characteristically purple spot lying in advance of valine and the leucines in the direction of movement of the phenol and between them in the collidine direction. This spot occupies a position different from any amino-acid the R_F values of which have been published, and may prove to be new. It has been found in chromatograms from *Polytrichum*, *Psilotum*, *Isoetes*, *Equisetum*, *Ginkgo*, *Ephedra* and *Cheiranthus*. It is possible that more concentrated hydrolysates would have shown its presence in the other tissues investigated. All the amino-acids named here have recently been reported for hydrolysates of the bacterium *B. coli*[13]. This remarkable correspondence of amino-acids in so widely separated groups of plants raises the question whether the significance is one of phylogeny or of essential metabolic requirements; but our present knowledge of the functions of the amino-acids is insufficient to warrant an answer.

In contrast to the amino-acid pattern of the hydrolysates, wide differences were found in those of the alcohol extracts. The free amino-acid content was notably low in mature tissues not specially adapted for storage. This was the case in leaves of *Isoetes* and *Angiopteris*, in thalli of *Gigartina* and *Conocephalum*,

and in stems of *Lycopodium*, *Equisetum* and *Psilotum*. Resting buds of *Ginkgo* and prothalli of *Equisetum* were also low in amino-acid content. No amino-acids could be detected in the leaf of *Angiopteris* and stem of *Lycopodium*, but in the other materials glutamic acid was always prominent in spite of the low total amino-acid content. Aspartic acid was also present in every case. The rather bulky prothalli of *Angiopteris* and *Osmunda* contained appreciable quantities of a few individual amino-acids. *Angiopteris* contained only aspartic and glutamic acids and a larger quantity of a substance, possibly a peptide, giving a purple reaction with ninhydrin but not occupying the position of any known amino-acid on the chromatogram. The *Osmunda* prothallus contained aspartic and glutamic acids, glutamine, a larger quantity of serine and a still greater amount of a substance occupying the same position as that of the unknown of *Angiopteris*. Slowly developing synangia of *Psilotum* and shoots of *Polytrichum* occupied a middle place in amino-acid content. In both materials, aspartic acid, glutamic acid, asparagine, glutamine and smaller amounts of other substances not further characterized were present. The only materials yielding a high proportion of free amino-acids were the developing flower buds of *Cheiranthus*, actively growing branches of *Ephedra* and induced branches of *Equisetum* and *Conocephalum*. In the two cases investigated in detail, namely, *Ephedra* and *Cheiranthus*, the chromatograms corresponded in individual amino-acids to the hydrolysates, but contained, in addition, asparagine and glutamine and several substances not yet identified.

The connexion emerging from this survey between content of free amino-acids (and peptides) and growth activity of the tissues appears too close to be lacking in significance. The abundance of free amino-acids found in actively developing tissue is apparently in contrast with the observations of Dent, Stepka and Steward[11], who record that under conditions of protein synthesis in potato disks, certain of the amino-acids decrease in amount to such an extent that they are no longer visible on the chromatograms. In their work, however, the synthesizing tissues were isolated from other sources of amino-acids, whereas in the present instance the growing tissues could draw on nitrogenous substances from the rest of the plant. The connexion between active growth and abundant supplies of free amino-acids is supported by the observations on induced branches of *Equisetum giganteum* and *Conocephalum*. In *Equisetum* removal of the shoot apices led to the rapid growth of lateral branches from the nodes. In *Conocephalum* rapidly growing branches developed from the edges of an old thallus placed in a warm damp atmosphere. In both materials the actively growing branches contained an abundance of free amino-acids which were comparatively deficient in the adjoining mature tissues.

The several points of interest emerging from this survey may now be summarized. In the first place, these preliminary observations indicate that the combined amino-acids of the apical meristems are not appreciably different in nature or proportion from those in mature tissues. A striking correspondence is also noticed between the amino-acids of acid hydrolysates of representatives from widely separated groups of plants. A connexion is found between the amounts of free amino-acids and the activity of development of tissue, and among the free amino-acids the ubiquity of glutamic and aspartic acids is very striking. It is a reasonable anticipation that many additional points of interest will emerge from use of quantitative methods in conjunction with paper chromatography.

In conclusion, I wish to thank Prof. C. W. Wardlaw for his encouragement and helpful criticism and Dr. C. E. Dent for his valuable advice on the technique of paper chromatography.

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PAPER CHROMATOGRAPHY OF ANTHOCYANINS AND RELATED SUBSTANCES IN PETAL EXTRACTS

By E. C. BATE-SMITH
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THE work of Lawrence and Scott-Moncrieff[1] indicates that in *Dahlia variabilis* five genetic factors control the development of petal colour. The factor *A* determines 'light' anthocyanin pigmentation, *B* 'heavy' anthocyanin, *Y* yellow anthoxanthin and *I* ivory anthoxanthin. A factor *H* inhibits the action of *Y*. In absence of *Y*, anthocyanin is mainly cyanin; but in presence of *Y* pelargonin preponderates. *Y*, when uninhibited by *H*, completely suppresses ivory anthoxanthin production by this factor *I*. The presence of *I* is indicated in cyanic types by a blueing effect on the petal colour.

The methods used by Lawrence and Scott-Moncrieff to identify these pigments were based on tests described by Robinson and Robinson[2]. An extract of the crushed petals in 1 per cent hydrochloric acid contains all the pigments, and from it the anthoxanthins can be extracted by repeatedly shaking with ethyl acetate. The anthocyanins react with sodium carbonate, giving a tint varying from blue to red-violet as the cyanic constitution varies from pure cyanin to pure pelargonin. Yellow anthoxanthin was detected by shaking the ethyl acetate extract with saturated sodium carbonate, giving an intense golden brown coloration[1]. Ivory anthoxanthin was detected by its giving a yellow or green reaction in these circumstances in absence of yellow anthoxanthin. In presence of the latter it was detected by the blueing effect of an acid anthoxanthin extract on a standard cyanin solution.

All four pigments, when present, can be readily demonstrated in a 1 per cent hydrochloric acid extract of petals by the paper chromatographic method of Consden, Gordon and Martin[3]. Phenol, collidine, and butanol–acetic acid–water (40 : 10 : 50 by volume) have been tried as solvents; the last-mentioned gives the best results, and has been used in all the present work. In this way the pigment

R_F VALUES IN BUTANOL–ACETIC ACID–WATER (40 : 10 : 50) AND COLOUR OF ANTHOCYANIDINS AND THEIR MONO- AND DIGLUCOSIDES

	Anthocyanin taken up in :	Cyanidin R_F	Cyanidin Colour in air	Cyanidin Colour in NH_3 vapour	Peonidin R_F	Peonidin Colour in air	Peonidin Colour in NH_3 vapour	Malvidin R_F	Malvidin Colour in air	Malvidin Colour in NH_3 vapour	Hirsutidin R_F	Hirsutidin Colour in air	Hirsutidin Colour in NH_3 vapour
	Water	0·19	Blue-mauve	Blue-green	0·27	Pink	Blue	0·24	Mauve	Blue-green	0·33	Mauve	Mauve
		(0·26)			(0·22)			(0·29)			(0·26)		
Diglucosides	1% HCl	0·14	,,	Blue	0·28	,,	,,	0·22	,,	,,	0·33	,,	,,
	5·5% HCl	0·12	,,	,,	0·20	,,	,,	0·23	,,	Blue	0·24	Rosy-mauve	Blue-mauve
	Water	0·32	Blue-mauve	Grey-blue	—			—			—		
Monoglucosides	1% HCl	0·31	Mauve	,,	—			—			—		
	5·5% HCl	0·21	,,	,,	0·32	Pink	Blue	0·32	Mauve	Blue	0·29	Rosy-mauve	Bluish
Aglucones	5·5% HCl	0·24	Mauve	Grey-blue	0·38	Pink	Grey-blue	0·54	Mauve	Grey-blue	0·51	Rosy-mauve	Bluish

The values in brackets in the first row of data refer to fainter spots accompanying the main spot. These were seen only in chromatograms of anthocyanin chlorides dissolved in water without further addition of hydrochloric acid. They are likely to represent tautomeric forms of the anthocyanin colour base. In hydrochloric acid only one spot corresponding to one anthocyanin type has been observed, and this forms an additional reason for preferring a hydrochloric acid to an aqueous extract.

constitution of a large number of seedlings can be demonstrated in a few hours, giving a permanent record which can be filed for reference purposes.

The results to be described were obtained mainly with *Dahlia variabilis* during the latter part of the 1947 season. Some at least of the R_F values quoted must be regarded as provisional. The values for cyanin, for example, vary to some extent from one run to another, and until the causes of this variation are understood and controlled the identity of an anthocyanin cannot be established by reference merely to its position on the chromatogram, nor with certainty even by comparison with a standard anthocyanin run side by side. Part of this variability has been traced to the effect of the hydrochloric acid with which the petals are extracted. In the case of cyanin, for example, the anthocyanin, changing colour at about *p*H 3, is present as the oxonium chloride in the original 1 per cent hydrochloric acid solution; but as it travels down the paper it is equilibrated with the acetic acid solution at a higher *p*H, and is partly converted into the colour base. The effect can actually be seen in a slight change in the colour of the spot from pink to mauve. The salt travels at a slower rate than the colour base, so that the R_F of an anthocyanin applied to the filter paper in hydrochloric acid solution is less than that applied in neutral solution.

In spite of this difficulty, the use of 1 per cent hydrochloric acid has a number of advantages. The spots formed are less diffused than those from aqueous extracts; and a uniform practice of running chromatograms from 1 per cent hydrochloric acid solutions smooths out any difficulties due to variation in sap *p*H and also makes it unnecessary to remove acid after carrying out mild hydrolysis.

The R_F values are, fortunately, not the only evidence upon which the identity of a pigment can be established. The spots formed by these substances have distinctive colours both in ordinary and ultra-violet light, and these colours also change in a distinctive way when the papers are treated with ammonia vapour. For example, cyanin forms a blue-mauve spot becoming blue-green in ammonia vapour, peonin a rose spot becoming blue. Apigenin forms an ivory spot scarcely visible in ordinary light but becoming lemon-yellow in ammonia vapour, and having a light-brownish fluorescence in ultra-violet light.

The ultra-violet source employed was an 'Osira' lamp having some emission in the visible region.

The identification of the sugars formed after hydrolysis of the glycosidic pigments by the application of Partridge's method[4] presents no difficulty provided sufficient material is available. It should be noted that certain polyphenols, for example, catechin, will reduce ammoniacal silver nitrate in the cold, and this will form an additional means of identification of such types.

Specimen Anthocyanins. A limited number of natural and synthetic anthocyanins have been available for comparison with the types found in petal extracts, namely: synthetic cyanin, peonin, malvin, and hirsutin chlorides; cyanin from cornflower (*Centaurea cyanus* Linn.) containing a second component thought to be cyanidin monoside; cyanidin monoside from blackberries (*Rubus fruticosus* Linn.) which proved to contain a second, unidentified component.

These have been chromatographed in aqueous and hydrochloric acid solution and also after subjection to progressive hydrolysis. The spots applied to the paper contained about 5 μgm. of the pigment chloride.

The R_F values obtained in butanol–acetic acid are given in the accompanying table.

Anthocyanins of D. variabilis. All cyanic varieties examined to date have shown two spots with R_F values varying between 0·12 and 0·19, and 0·25 respectively. After removal of acetic acid from the paper the former is blue-mauve and corresponds exactly in behaviour with the natural and synthetic cyanin. The second is rose-pink, and can be taken, pending similar confirmation, to represent pelargonin.

D. Merckii, on the other hand, shows in the ray petals two blue-mauve spots, R_F 0·12 and 0·16, the first corresponding with cyanin and the second of uncertain identity, pelargonin being absent. The disk florets, shown by Lawrence and Scott-Moncrieff to contain cyanidin 3-monoside[1], also form two blue-mauve spots, one, unidentified, moving with R_F 0·06 and one corresponding with cyanidin monoside.

The presence of cyanidin monoside in deeply pigmented chocolate flowers of *D. variabilis*, reported by Lawrence and Scott-Moncrieff, is confirmed by the presence in the chromatograms of a mauve spot with R_F 0·31.

Anthocyanins of other species. Results with a number of other species which bring out points of particular interest may be mentioned.

Peristrophe speciosa (Necs.), reported to contain cyanidin diglycoside[5], shows no spot where cyanin would be expected, but shows a slow spot (R_F 0·04–0·06) of a bright rose colour. On hydrolysis with 5 per cent hydrochloric acid at 100° C. for five minutes, spots are formed which correspond with cyanidin monoside and cyanidin respectively.

Iris unguicularis Poir., reported to contain delphinidin diglycoside[5], gives two spots, $R_F \sim 0{\cdot}2$ and 0·25, both bluer in colour than cyanin and becoming green in ammonia.

Tibouchina semidecandra Cogn., reported to contain acylated malvin[5], has one very fast moving mauve spot, $R_F \sim 0{\cdot}63$, and a fainter one, $R_F \sim 0{\cdot}44$, becoming bright green with ammonia. On hydrolysis (as for *Peristrophe*) a spot corresponding with malvidin monoglucoside (R_F 0·31) appears.

Reviewing the data on anthocyanins as a whole, it can be seen that increase in hydrochloric acid concentration in the applied solution causes a fall, removal of a glucosidal sugar and methylation cause a rise, in R_F value. Certain regularities are apparent, but there are numerous anomalies in the way of consistent interpretation of the differences in R_F in terms of differences in constitution. Nevertheless, the position of a spot giving the colour reactions of a particular anthocyanidin type can already yield useful information as to its probable nature, especially if this knowledge is extended, as in the case of the *Peristrophe* and *Tibouchina* pigments, by chromatography of its hydrolysis products.

Yellow Anthoxanthin. In *Dahlia* this pigment has been identified by Price as the chalkone butein[6]. The pigment produces a long trail with all solvents tested, but there are concentrations into definite spots, the main one having R_F 0·55. After heating with 8 per cent hydrochloric acid for ten minutes at 100° C. the pigment becomes almost insoluble in water and its R_F increases to 0·85. This behaviour could be accounted for either by hydrolysis of a glycoside or by ring closure to the flavanone butin. That the former is more likely is indicated by the behaviour of a number of hydroxy chalkones (2- and 4-hydroxy, 2,3- and 2,4-dihydroxy and 2-hydroxy-4-methoxy chalkone), all of which had $R_F \sim 0{\cdot}9$. This would confirm Price's view that butein occurs as a glycoside in the dahlia petal. Owing to the trailing of this constituent it is advisable to remove it by extraction with ethyl acetate when studying anthocyanins.

Ivory anthoxanthin. Chromatograms of blue-red, rosy magenta and some white *Dahlia* petal extracts when treated with ammonia vapour show an evanescent lemon-yellow spot with $R_F \sim 0{\cdot}6$. Unless so treated this spot is not visible in ordinary light, but gives a characteristic light-brown or cream-coloured fluorescence in ultra-violet light (*cf.* accompanying illustration).

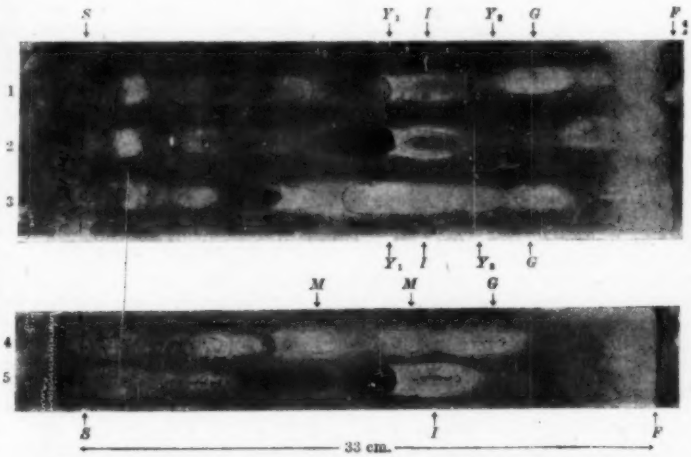
The ivory anthoxanthin in *Dahlia* was identified by Schmid and Waschkau[7] as apigenin and was thought to be non-glycosidic. This identification of the flavone has been confirmed by comparison with apiin, the 5-apioglucoside of apigenin. The following evidence suggests that the anthoxanthin is present in the petal as a glycoside.

Apiin gives a spot with the same characteristics as the *Dahlia* anthoxanthin spot, but with R_F 0·5. When subjected to mild hydrolysis in 1 per cent hydrochloric acid the R_F increases to 0·6. Hydrolysis in 10 per cent hydrochloric acid increases the R_F still further to 0·85, the fluorescent character of the spot remaining unchanged throughout. It is likely that these changes in R_F are due to the successive removal of apiose and glucose, and that the spots observed in the *Dahlia* extract chromatograms are due to a glycosidal derivative of apigenin, probably the 5-glucoside, rather than to the aglucone.

Other components of white petal extracts: substances giving colour reactions with ammonia. Lawrence and Scott-Moncrieff pointed out that white flowers free from apigenin may give a strong straw or maize colour when treated with ammonia vapour. The extract of one such flower, *DJ*/18 (an F_2 seedling from 'Murdoch' × 'Frau O. Bracht'), showed two spots, $R_F \sim 0{\cdot}4$ and 0·55, which gave permanent brownish stains when treated with ammonia. In ultra-violet light the untreated spots were barely visible; but after treatment they fluoresced strongly (straw-coloured). It was suggested[1] that the substances responsible are tannins, and this possibility is being investigated by surveying the chromatographic behaviour of tannins and related substances.

To sum up, this investigation has shown promise of the possibility of identifying the anthocyanins, flavones and related substances present in petal extracts, employing their colour in visible or ultra-violet light, with and without treatment with ammonia vapour, their reaction with ammoniacal silver nitrate and their R_F values as distinguishing characteristics.

Even without exact identification of all the substances responsible, the spots seen on the chromatogram provide a means of rapidly characterizing genetical material and of tracing relationships between genotypes (*cf.* accompanying illustration).



CHROMATOGRAMS OF EXTRACTS OF PALE YELLOW AND WHITE FLOWERS. APPEARANCE IN ULTRA-VIOLET LIGHT

1. "Frau O. Bracht" (pale yellow). 2. "Ballego's Surprise" (white sport from 1). 3. "D.J.L." (pale yellow seedling from 1). 4. "*DJ*/18" (white seedling from 3). 5. "Snow Princess" (white)

Y_1, position of main butein spot, the only constituent of these flowers giving spots visible in ordinary light; Y_2, light brown spot corresponding with a secondary concentration of butein colour; *I*, apigenin (? glucoside); *M*, spots becoming brown in ammonia vapour; *G*, spots showing bright green fluorescence; *S*,*F*, start and finish of chromatograms. Note (*a*) absence of *G* as well as Y_1 and Y_2 from 2: otherwise identity of 1 and 2; (*b*) similarity of closely related 1 and 3, markedly different from unrelated 5.

Osira lamp. Ilford Rapid Process Panchromatic plate. Ilford Micro 4 filter. (Photographs by Dr. R. Gane and Mr. D. P. Gatherum)

Its greatest potential value would, therefore, appear to lie in the field of chemical genetics opened up by the work of Lawrence and Scott-Moncrieff which inspired the present investigation.

The help afforded by Prof. A. R. Todd in supplying anthocyanin chlorides and chalkones and by Dr. R. Hill in supplying natural anthocyanins and flavones made this investigation possible. Mr. D. F. Elsden carried out the experimental work, and Dr. S. M. Partridge's advice in its interpretation is gratefully acknowledged.

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OBITUARIES

Prof. A. S. Eve, C.B.E., F.R.S.

ARTHUR STEWART EVE, who died on March 24 at his home at Puttenham in Surrey, was one of Rutherford's collaborators in early days at McGill. Throughout his life he had a fervent admiration for Rutherford, and his authoritative biography of Rutherford was a work of love.

The main facts of Eve's life are simple. Born in 1862 at Silsoe in Bedfordshire, he was educated at Berkhamsted School, whence he passed with a scholarship in 1881 to Pembroke College, Cambridge. He was fifteenth Wrangler and took a first-class in Part 2 of the Natural Science Tripos. He then went as a master to Marlborough, where he stayed for sixteen years, during the last five of which he was bursar. In 1903 he went to McGill, first in the mathematics and later in the physics department, and in the next year a series of papers began dealing with ionization by β- and γ-rays, with the ionization in the atmosphere and, somewhat later, with the amounts of radioactive substances present in rocks and in sea water. In 1909 he succeeded Rutherford as Macdonald professor of physics. Work was interrupted by the First World War, when Eve was responsible for raising the third and fourth University Companies as reinforcements for the Princess Patricia's Canadian Light Infantry. He went overseas as second in command of the 148th Battalion with the rank of major, and afterwards became a colonel in the Canadian Expeditionary Force. Though admirably suited to the command of men, the need for men with scientific training to deal with the submarine menace led to his becoming director of research at the Admiralty Experimental Station at Harwich. For his work there he was awarded the C.B.E. in 1918; in 1917 he had become a fellow of the Royal Society.

After the War he returned to McGill as director of physics, became dean of the Graduate Faculty in 1930 and retired with the title emeritus in 1935. In 1929 he was president of the Royal Society of Canada.

After his retirement to England came his 'life' of Rutherford, and he then undertook the heavy and long-delayed task of writing the life of John Tyndall from the large mass of material collected and partly arranged by Mrs. Tyndall. Eve produced a first draft, but a stroke prevented him from completing the book, which was eventually published in collaboration with C. H. Creasey and under their joint names.

Eve's true greatness lay in his personality, and this was at no time better shown than in his last years when by cheerful pluck and determination he recovered to a large extent from the stroke which had at first deprived him of speech and movement. He regained the power of speech and to some extent that of walking; he even managed to make his occasional lapses add piquancy to his always racy speech. It is a measure of his great-heartedness that he was able to turn these errors of speech into a joke embarrassing neither to his friends nor to himself. He had a rare sympathy and the widest of interests. It is primarily these that made him the successful teacher that he was, though his excellent text-books show the clearness of mind that is also essential. Few men have made so many friends and so few enemies.

In his researches on ionization Eve showed ability in handling the primitive apparatus of the day and in making clear and logical deductions. Reading them in the light of after-events, it is tantalizing to see how near he came to the discovery of cosmic rays. Though the ionization over land agreed reasonably well with what must be caused by traces of emanation and other known radioactive effects, all of which he carefully measured, it was difficult to account for the ionization over sea. This difficulty he clearly states, and perhaps if he had had more opportunities for measurements at sea he would have proved the existence of another source of ionization.

His text-book "College Physics", written in collaboration with Mendenhall and Keys and recently revised, is still widely used.

Eve was one of the first physicists of distinction to concern himself with the use of physical methods in prospecting in the nineteen-twenties. He published a series of papers, with D. A. Keys and others, dealing especially with the electrical and magnetic methods, and his influence was important in promoting the use of geophysics in Canada. His book on the subject, with D. A. Keys, is an admirable exposition well adapted for men with only a moderate knowledge of physics.

In 1905 he married Miss Elizabeth Brooks of Montreal. She survives him, as do one son and two married daughters.

G. P. THOMSON

Dr. J. G. Parker

DR. JAMES GORDON PARKER died on April 30 at his home in London in his seventy-ninth year. He was born on August 30, 1869, at Newport, Fife, and received his early education at the Madras College, Scotland, and then proceeded to Owens College, Manchester. With this foundation, he went for periods to the Universities of Heidelberg and Göttingen, and thence to the University of Strassburg. It was from here that he received his degree of Ph.D. in 1891, the subject of his thesis being "Ueber Neue Synthesen mit Brenztraubensäure".

Family associations gave him an interest in the leather industry, and for a short time he went to the University of Leeds with the late Prof. H. R. Procter and worked in the Leather Industries Department. Then, to obtain some experience in Continental leather manufacture, he went to Germany for a few years (he spoke German fluently).

So well equipped, he was appointed head of the Herolds Institute, Bermondsey, the first tanning school in London, which was opened in 1897. He remained here until 1909, when the school was transferred to the newly erected Leathersellers' Technical College, Tower Bridge Road, S.E.1, and he was principal of the College from that date until 1928, when he retired. He was elected a fellow of the Royal Institute of Chemistry in 1909. On retirement, he continued in private practice as a consulting chemist to the leather industry, and was internationally known as an authority in this branch of chemical technology.

During the First World War, Dr. Parker was appointed a member of the Leather Supplies Committee at the War Office, and of the Allied Commission of Supplies, where his experience was placed freely at the disposal of the Government. For many years he was examiner in leather manufacture for the City and Guilds of London Institute. During the period 1914–18 he was also honorary secretary of the London Tanners' Federation and the United Tanners Federation. He was an honorary liveryman of the Worshipful Company of Leathersellers, and held the Order of Leopold (second class) and the Order of the Crown of Italy. In 1904 he was awarded the Silver Medal of the Royal Society of Arts for his investigations into the causes of the deterioration of bookbinding leathers.

Dr. Parker will be best remembered for his work in the formation and development of the International Association of Leather Trades' Chemists. The Association was formed in 1897, and at the time of his death he was one of the two remaining original members. That Association later developed into the International Society of Leather Trades' Chemists, with sections in many parts of the world (the Society was recently dissolved with the formation of autonomous societies and an international Union). He was the first secretary of the Association, and remained so until 1912, when he was elected president for the years 1912–14. He was awarded the Association's Gold Medal in 1912. After the First World War, he was elected president of the then newly formed International Society for 1920–21, then treasurer for a period, and finally honorary secretary from 1929 until a year or so ago, when ill-health compelled him to forgo many of his activities. He was elected an honorary member of the Society in 1934.

Dr. Vaughan Cornish

Dr. Vaughan Cornish was a son of the vicarage, one of the most valuable groups in our national life, and his father's articles on Nature in south-eastern England in the late nineteenth century are still remembered for their intrinsic value and the beautiful form in which they were given. Dr. Cornish therefore had a good heritage of a kind he was to develop by his own efforts to understand, and to spread the understanding of, natural beauty. He was born in 1862 when his father was vicar of Debenham, Suffolk. After attending St. Paul's School, he studied chemistry at the University of Manchester, ultimately taking the D.Sc. degree and becoming director of technical education under the Hampshire County Council. In 1891 he married Ellen Agnes Provis and, with her, planned travel and research. His earlier researches, continued throughout life, were on waves —of water, snow and sand, on sea beaches, sandbanks, sand-dunes and snowdrifts. The Royal Geographical Society recognized his work by giving him the Gill Memorial Award in 1900. Earthquake waves were also studied in Jamaica in 1907, when both Dr. and Mrs. Cornish were injured; and the results of the inquiries were published in the *Geographical Journal* of 1912. In 1903, Dr. and Mrs. Cornish went around the world, making a special study of Japan, and later on they paid several visits to Panama to study the Canal while it was under construction. In 1911, Mrs. Cornish died and her husband some time afterwards published "The Travels of Ellen Cornish" as a tribute to her memory.

During the First World War, Dr. Cornish did a great deal of lecturing on strategic geographical questions to groups of officers in all branches of the Services, and thereby developed his interest and understanding of many matters of environmental conditioning of social and political life, the political side being more prominent in his mind and work. One of his best known books is "Great Capitals", with its analysis of the situations of capitals in their relations with the country concerned in each case. Dr. Cornish was a well-known and frequent contributor to the work of the British Association for the Advancement of Science, and in 1923 was president of Section E (Geography) of the Association. He was also a faithful friend of the Geographical Association and occupied its presidential chair. One remembers the distinguished figure wandering around at meetings looking for some fine piece of architecture, or some gem of natural scenery to be sketched and studied and discussed from an æsthetic rather than from a historical point of view. He gave much thought to the work of the Council for the Preservation of Rural England and wrote for it "The Scenery of England" (1932); but his most personal interest was in trying to use æsthetics as a channel of approach to truth. "The Poetic Impression of Natural Scenery" (1931) is but the best known of his many efforts in this field. If one cannot point to any very definite doctrine of his concerning æsthetics, we can appreciate, perhaps all the more, the spirit of the searcher after truth who had learned from a scientific training that truth is too great to need propagandist crutches.

Dr. Cornish's second wife was Miss Watson, who was the widow of Mr. E. A. Floyer. In his later years Dr. Cornish derived much pleasure from the inheritance of South Combe farm on which is Salcombe Hill, Devon. He gave this hill-top to the public and supported efforts to protect public amenities in Devon.

We regret to announce the following deaths:

Prof. W. T. David, professor and head of the Engineering Departments of the University of Leeds, on May 22, aged sixty-two.

Mr. G. L. Overton, formerly a member of the staff of the Science Museum, London, on May 22, aged seventy-two.

Dr. G. H. Pethybridge, O.B.E., formerly mycologist to the Ministry of Agriculture and Fisheries and assistant director of the Ministry's Plant Pathology Laboratory, Harpenden, Herts, on May 23, aged seventy-six.

Mr. J. J. Shaw, C.B.E., who maintained his own seismological observatory at West Bromwich, on May 23, aged seventy-four.

NEWS and VIEWS

Royal Botanic Gardens, Kew: Dr. N. L. Bor, C.I.E.

Dr. Norman Loftus Bor, who was recently appointed assistant director of the Royal Botanic Gardens, Kew, had a distinguished career at Trinity College, Dublin, and the University of Edinburgh, and was awarded his doctorate for a thesis on the "Synecology of the Naga Hills". He has had wide experience in forest and general administration in the Indian Forest Service during 1921–46. He was political officer of the Balipara Frontier Tract during 1931–34, deputy commissioner of the Naga Hills in 1935 and acting inspector-general of forests in 1939. During 1942–46 he held a responsible position in relation to evacuation, reconstruction and rehabilitation on the North-East Frontier. He has travelled extensively in India and the Near East. During 1937–42 he was forest botanist at the Forest Research Institute, Dehra Dun, and in recent years has carried out research on the Indian species of the Gramineæ. Dr. Bor's published botanical works deal with the taxonomy of Indian plants and with the ecology of Assam and the Nilgiri Hills. In particular, he has concentrated on the study of grasses and has described new species from various parts of India. Recently, at Kew, he has made a detailed study of the Indian species of *Poa*.

National Museum of Wales: Sir Cyril Fox, F.B.A.

It is sad to realize that the time has come for Sir Cyril Fox to retire from the post of director of the National Museum of Wales. The old saying may be true, "Le roi est mort, vive le roi", but his successor will find it no light matter to continue Sir Cyril's distinction as a researcher and his efficiency as an administrator. Fox was educated at Christ's Hospital and Cambridge. He was always an ardent archæologist, even in the days of long ago (1912–24) when at Cambridge he occupied the post of superintendent of the University Field Laboratories. Indeed it was at this time that his great work, "The Archæology of the Cambridge Region", which gained him his Ph.D., was written and published, and that he did so much splendid voluntary work for the Cambridge Museum of Archæology and Ethnology, where his beautiful lettering on the labels of things he arranged is still admired. In 1924 he was elected a Kingsley Bye-Fellow of Magdalene College, and later—after his nomination to the directorship of the National Museum in Dublin by the Irish Academy had been refused by the then Irish Civil Service on the grounds that he was an Englishman—he became a keeper and lecturer in the National Museum of Wales, of which he was soon to become the director. Sir Cyril has, not unnaturally, been president of a number of archæological societies, and has published regularly the results of his researches. His most thought-productive work, perhaps, has been "The Personality of Britain", which has passed through no less than four editions. There are other archæologists who can claim a high degree of scholarship and achievement, but few who can inspire and charm as does Sir Cyril Fox; to be with him is indeed an inspiration. The best wishes of all go to him in his retirement at Exeter, where his wife is lecturing and where we may be sure he will have retired only from administration, and will doubtless pursue his researches with continued zest and a freer mind.

Mr. D. Dilwyn John

Mr. David Dilwyn John, who is succeeding Sir Cyril Fox as director of the National Museum of Wales, is a graduate of the University of Wales. He served as a zoologist on the staff of the *Discovery* Investigations during 1925–35, making three voyages to the Antarctic, and was later awarded the Polar Medal. In the course of one of these commissions, while he was in charge of the scientific work, the first winter circumnavigation of the southern continent was made. His researches into the development and distribution of southern Euphausiidæ, based on material much of which he had himself collected, resulted in a report which is a fundamental contribution to our knowledge of the natural history of these important Antarctic crustaceans. On appointment to the British Museum (Natural History) in 1935, Mr. John was put in charge of the collections of Echinoderms, and his principal publications in recent years have been related to the subject of his specialization. In particular, he has concentrated on collections of Crinoidea made by such expeditions as the *Discovery*, *Scotia*, *Belgica* and the British, Australian and New Zealand Antarctic Expedition in high latitudes, and besides the taxonomic results obtained, themselves of great value, he has thrown much interesting light on viviparity in the Crinoidea and the care of the brood by the parent animal. A Territorial Army officer prior to the War, he was on military service until 1946; he became a deputy keeper in the Department of Zoology in February of this year.

World Co-operation in Science

Prof. J. D. Bernal's recent presidential address to the Association of Scientific Workers contains some points which merit the notice and support of all scientific workers. He directed attention to the danger which retarded capital expenditure involves to industrial development and research, and also to the consequences to scientific effort if the reconstruction plans of the universities and research laboratories should be curtailed or postponed. He emphasized that neglect and waste of resources, both material and human, continue, and quoted Sir Henry Tizard's statement to the Parliamentary and Scientific Committee that on existing knowledge productivity could be raised by fifty per cent. As he very truly remarked, the hope of Great Britain, economically, culturally and scientifically, lies in the extent of its links with all other countries, with the United States no less than with Soviet Russia, with Eastern no less than Western Europe, and with the Colonial peoples. The world requires the flourishing of science as a basic condition of human happiness, even of human life itself; but scientific men by themselves form a weak minority, and can only be effective if they associate themselves with all others who have a common will for reconstruction and peace. Much of Prof. Bernal's address, however, was an attack on the Marshall plan for aid to Europe and the Government's policy of removing communists from key positions in defence research which ignores both the totalitarian threat to the freedom of science in Soviet Russia and the question of loyalties which has compelled Government action in Britain against communists.

Higher Technological Education in Britain

THE University Grants Committee has appointed a sub-committee to advise it on matters affecting technology in the universities of Great Britain, and to consider questions of higher technological education in consultation with the National Advisory Council on Education for Industry and Commerce, appointed by the Ministry of Education. The sub-committee consists of: Dr. A. E. Trueman (chairman), Prof. J. F. Baker, Sir Alan Barlow, H. W. Cremer, Sir Charles Darwin, Sir Peter Innes, Prof. Willis Jackson, Sir Andrew McCance, Prof. Andrew Robertson, Prof. J. B. Speakman, Sir Raymond Streat, Sir Henry Tizard, and Sir Charles Ellis.

B.C.U.R.A. Quarterly Gazette

THE *B.C.U.R.A. Quarterly Gazette*—a new publication of the British Coal Utilization Research Association—is designed to give a more colourful account of the Association's work and to serve a wider range of readers than a rigorously scientific journal. To factual accounts of research and development projects, it will add a running commentary on the Association's staff and their activities. The circulation will not be limited to members only. The first number contains a survey by Sir Charles Ellis, president of the Council, as it finds itself in a nationalized coal industry, covering its members, staff, accommodation, work and prospects. There follow articles on technical achievements in course of development. B.C.U.R.A. Patent No. 1 describes the down jet furnace, which employs a revolutionary system of combustion of solid fuels. Normal combustion on a grate is beset by limitations owing to the presence of ash and volatile matter in the fuel. These are avoided by the new technique, which provides freedom to work at greater intensities and for longer durations. The exploitation of these ideas is only in its infancy. Another item deals with the Association's work on domestic heating by open coal fires, which normally radiate not more than 25 per cent of the heat of combustion. Work in past years has shown the possibility of increasing this by one or other method—especially by supplementing radiation with heat convection. To-day the consumers' progress towards fuel economy is limited by lack of availability of efficient appliances. Sometimes these are too costly or even only to be obtained in a new house. The article describes a new inset fire which can be fitted into an existing grate at a moderate cost. It is designed by Mr. J. S. Hales and Mr. T. W. Grieve and claimed to be capable of high thermal efficiencies. When burning normal house coal, the total output of heat—by radiation and convection combined—reached 37 per cent; with coke, the figure reached 48 per cent of the heat of combustion. In addition, by reducing the flow of heat up the chimney to one change per hour, draughts are minimized and comfort improved.

Medical Group Practice in the United States

THE review of the development and characteristics of Medical Group Practice in the United States which Political and Economic Planning has issued as Broadsheet No. 274 is of special interest in view of the obligations placed on local authorities in Britain under the National Health Service Act to provide, equip and maintain health centres staffed and run by medical practitioners working as a team. The survey shows that American group practice aims at providing a full general and specialist service, including, if possible, in-patient treatment, and in the United States the term is applied to almost any form of organised medical team-work. The main incentives appear to be the inability of individual practitioners to provide a sufficiently complete service, the desire for professional co-operation among medical men and the need to reduce the cost of medical care by decreasing overhead expenditure and bringing specialist and hospital services to undeveloped areas. The main criteria are organised team-work and pooling of income. Day-to-day consultations are supplemented by staff meetings, good record systems, and sometimes also by democratic methods of administration. Groups show much interest in keeping their members up to date and developing their skills, for example, by good libraries, paid annual study leave, and systematic training of junior members. Financial competition within the group not only hinders team-work but also results in friction, and no solution has yet been found for the problem of assessing financially the diverse and constantly changing ability of physicians. The election of group members is of the highest importance and should be done by the medical men themselves. Some are temperamentally unsuited for group work and should be excluded. Good group practice may have a beneficial influence on medical standards over a wide area; but in view of the important differences in social background, in the development of health services and in the organisation of the medical profession in the United States, careful consideration will be necessary before the lessons of American experience can be applied to Britain.

British Trust for Ornithology

THE work of the British Trust for Ornithology (91 Banbury Road, Oxford) is described in the fourteenth annual report which has recently been issued. Much useful information has been collected from the hatching and fledging inquiry and will be included in the new edition of the "Handbook of British Birds". A sample census of heronries showed that large decreases were recorded in every considerable area and in the majority of individual heronries; this was almost certainly due to the extreme severity of the winter. The black redstart inquiry showed that, up to the end of the year, sixteen pairs were reported to have lived in the south of England. Other inquiries have been made into the behaviour of tits with milk-bottles and the nocturnal activities of redwings; but probably the most popular was the watch for swifts on May 11, 1947. Five hundred observers made reports on the movements of about five thousand birds, three out of every four of whom were headed north. Above a line drawn from the Wash to the Severn this northward surge was especially marked, and in south-west Devon several parties of swifts were seen to come in from the sea and to proceed inland.

Megalithic Tombs in Scotland and Ireland

PROF. GORDON CHILDE'S present ideas on the Megalithic tombs in Scotland and Ireland are put on record in a paper read before the Glasgow Archæological Society (*Trans.*, **11**; 1947). Recent discoveries have caused him to modify some details of his exposé made in the same publication for 1931. No longer, for example, is "the priority of Scottish passage

graves over against English or Irish" maintained. The chief discoveries made in the last ten years have been those of no less than seventy horned cairns covering segmented cists in Ulster which, allowing for local differences, can be equated with the tombs of the Clyde and Solway coasts. Beacharra ware occurs in both these series of tombs. Further, it would appear that in Megalithic tomb times, south-west Scotland, north-east Ireland and the Isle of Man formed one province, while central and western Ireland and Scotland north of the Great Glen constituted another. Lastly, Prof. Childe uses the new discoveries to suggest an explanation of the anomalous occurrence of long cairns, horned at both ends, which have been found in northern Scotland.

Raffles Museum, Singapore

THE *Bulletin of the Raffles Museum* was suspended in 1941 when the Japanese occupied Singapore. It has now been revived, and the first issue of the new series (No. 18, October 1947) is made up of papers prepared before the occupation and preserved in the Museum. It is devoted almost entirely to the natural history of Christmas Island in the Indian Ocean and based on collections and field notes made on the island by C. A. Gibson-Hill between September 1938 and November 1940. Much of the bulletin describes the birds of the island; but notes are also included on the nature of the coast, climatic conditions from July 1939 to June 1940, echinoderms, Brachyura, terrestrial crabs, Arachnida, Isoptera, heterocerous and rhopalocerous Lepidoptera, terrestrial reptiles and mammals. The *Bulletin* also contains an obituary notice of the late director, F. N. Chasen, who was killed by enemy action in 1941.

Textile Institute: Annual Conference

THE subject of the annual conference of the Textile Institute, to be held at Buxton during June 2–5, will be "The Organisation of the Textile Industry". Among the authors of papers are Sir William Palmer (chairman, British Rayon Federation), Dr. F. C. Toy and Dr. D. W. Hill (British Cotton Industry Research Association) and Prof. A. N. Shimmin and Prof. A. J. Brown (University of Leeds). The Institute will also discuss its own role in the organisation of the industry at the opening session on June 2, when chairmen of its various committees will describe the work of their sections and their plans for the future, dealing in particular with education, standardization, publication, co-ordination, liaison and the status of the textile technologist. Foreign visitors to the conference include B. Hellmann and Dr. Zoltan Szaloki, who are to present a paper on "Textile Planning and Modernization in Czechoslovakia". Mr. Harold Wilson, President of the Board of Trade, has agreed to address the conference on June 2.

Science Service Officers

DR. KARL LARK-HOROVITZ, chairman of the Department of Physics, Purdue University, Lafayette, Indiana, and Charles E. Scripps of Cleveland, Ohio, have been elected trustees of Science Service, of Washington. Mr. Scripps represents the E. W. Scripps Estate, of which he is a trustee, while Dr. Lark-Horovitz represents the American Association for the Advancement of Science, of which he is general secretary. The following officers have been re-elected: *President*, Dr. Harlow Shapley, director of Harvard College Observatory; *Vice-President and Chairman of the Executive Committee*, Dr. Alexander Wetmore, secretary of the Smithsonian Institution; *Treasurer*, O. W. Riegel, director of the Lee School of Journalism, Washington, and Lee University, Lexington, Virginia; *Secretary*, Mr. Watson Davis, director of Science Service, Washington, D.C. Additional members of the Executive Committee are Mr. Frank R. Ford, editor of the Evansville Press, Evansville, Indiana; and Dr. E. G. Conklin, Princeton University, Princeton, New Jersey.

British Medical Association: Annual Scientific Meeting

THE first annual scientific meeting of the British Medical Association since the War will be held at Cambridge during June 25–July 2, under the presidency of Sir Lionel Whitby, regius professor of physic in the University. Among the topics of particular scientific interest announced for discussion are: recent advances in knowledge of the *Rh* factor in blood; plasma and blood derivatives in the treatment of burns; human relations in industry; prophylaxis of virus infections; radioactive isotope therapy; aviation medicine; nutrition; antihistamine substances.

International Summer School in Social Biology

THE British Social Hygiene Council is organising a Summer School on "The International and Cultural Relations of Social Biology", at the University, Lausanne, Switzerland, during August 18–September 1. During the first week of the School, there will be two morning and one evening lecture sessions each day, except Sunday, while the second week will be free for visits, excursions, and personal recreation. The course is intended for students of biology, teachers, social workers, men and women in administrative positions, and all who are interested in problems of human welfare and culture. The estimated cost, including travel, hotel accommodation and tuition, will be about £35. Further information can be obtained from the Secretary, British Social Hygiene Council (Dept. S.J.1), Tavistock House North, Tavistock Square, London, W.C.1.

Summer School in Health Education

THE Central Council for Health Education is holding its annual Summer School in Health Education at 'High Leigh', Hoddesdon, Hertfordshire, during August 11–25. In addition to the basic lectures in physiology (by Prof. Samson Wright), psychology (by Prof. James Drever), the biology of infection (by Dr. Robert Cruickshank), and social factors affecting health (by Prof. J. M. Mackintosh), Dr. H. A. Wilson, the Bishop of Chelmsford, will speak on "The Spiritual Needs of Man", and Sir Alexander Fleming on "Penicillin". An interesting new development is that of a course of nature study, with rambles and evening discussions, illustrated by films, strips and bird-song records. The School will appeal especially to educational and medical administrators, doctors, teachers, youth leaders, public health nurses, industrial nurses, industrial welfare workers, training organisers and students. Further information can be obtained from the Medical Adviser and Secretary, the Central Council for Health Education, Tavistock House, Tavistock Square, London, W.C.1. The inclusive cost of the course per person will be £16 16*s*.

Conference on Individual Freedom and Social Responsibility

THE tension between society and the individual was emphasized by more than one speaker at the Ethics and Science Conference organised by the British Social Hygiene Council in March this year. This conflict, recurrent in every age, but particularly acute in our own, was felt to be one meriting closer examination than was possible at the time, and for this reason another Ethics and Science Conference has been arranged for Thursday, June 10, when the subject will be "Where does Freedom End?" On one hand, the individual is faced with certain obligations towards the community—obligations which seem to increase in number with the growth of the welfare State. On the other hand, there is the urge to self-expression, which only too often appears to conflict with man's social responsibilities. The need for reconciling these two principles is present in every department of life, but is nowhere more clamant than in the spheres of home and work. The Conference will therefore concentrate on these two aspects of the problem, Canon V. A. Demant, of St. Paul's Cathedral, dealing with the first, and Prof. T. S. Simey, professor of social science in the University of Liverpool, with the second. The Conference will take place in the Livingstone Hall, London, from 2 p.m. until 5.30 p.m., and ample time will be allowed for discussion. Tickets (price 2*s.* 6*d.*) and further information may be obtained from the Secretary, British Social Hygiene Council (Dept. S.J.1), Tavistock House North, London, W.C.1.

Conference on the Overseas Territories of Western Europe

A STUDY Conference on the Overseas Territories of Western Europe is to be held in the Indisch Institut, Amsterdam, under the joint auspices of the Allied Circle, Amsterdam, and the British Society for International Understanding, during June 9–12. The purpose of the Conference is to study in their widest aspects the implications for the Overseas Territories of the union which is in process of formation between the countries of Western Europe; to promote mutual understanding of the actual conditions, needs and possibilities of the countries for whose well-being the British, French, Belgian, Netherlands and Portuguese Governments are responsible outside Europe; to learn what steps have been taken or could be taken to develop collaboration between them in the spheres of economics, social welfare and security, and to consider the education of public opinion upon this important subject. Further information can be obtained from the Secretary, British Society for International Understanding, Benjamin Franklin House, 36 Craven Street, London, W.C.2.

The Night Sky in June

NEW moon occurs on June 7d. 12h. 55m., U.T., and full moon on June 21d. 12h. 54m. The following conjunctions with the moon take place: June 8d. 23h., Mercury 4° S.; June 9d. 04h., Venus 3° S.; June 11d. 17h., Saturn 4° S.; June 13d. 08h., Mars 4° S.; June 21d. 01h., Jupiter 4° N. In addition to these conjunctions with the moon, Mercury is in conjunction with Venus on June 30d. 19h., Mercury being 1·0° S. Mercury is an evening star at the beginning of the month, but towards the middle of the month is too close to the sun for favourable observation, and is in inferior conjunction on June 24. Venus is conspicuous in the western sky, setting at 22h. 35m. and 21h. 10m. on June 1 and 15 respectively, and is in inferior conjunction on June 24. Mars is still visible as an evening star, setting at 0h. 48m. and 23h. 15m. at the beginning and end of the month respectively, and Saturn, which is fairly close to Mars, sets on the corresponding dates shortly after midnight and 22h. 22m. respectively. Jupiter, in opposition on June 15, is visible throughout the night, but is rather low for good observation in northern latitudes. No occultations of stars brighter than magnitude 6 occur in June. Summer solstice occurs on June 21d. 12h.

Announcements

THE RIGHT HON. SIR STAFFORD CRIPPS has been elected a fellow of the Royal Society under Statute 12 of the Society, which provides for the recommendation by the Council of persons who "have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society".

PROF. E. O. LAWRENCE, professor of physics and director of the Radiation Laboratory, University of California, Berkeley, has been elected an honorary fellow of the Physical Society.

THE following have been elected officers of the Royal Aeronautical Society for the year 1948–49: *President*, Dr. H. Roxbee Cox; *Past Presidents*, Sir Frederick Handley Page, Sir A. H. Roy Fedden; *Vice-Presidents*, Sir John Buchanan, Mr. W. G. A. Perring, Mr. N. E. Rowe; *Hon. Librarian*, Mr. J. E. Hodgson; *Hon. Treasurer*, Captain C. F. Uwins; *Secretary*, Captain J. Laurence Pritchard

IN connexion with the next General Assembly of the Union Radio Scientifique Internationale, to be held at Stockholm in July (*Nature*, May 1, p. 695), Unesco is contributing 3,000 dollars to the travelling expenses of the official members of the Union who will attend the meeting, and another 3,000 dollars to the publication of the report of the General Assembly.

A SYMPOSIUM on "The Genetics of Cancer", organised by the Genetical Society of Great Britain and the British Empire Cancer Campaign, is being held during June 24–25 in London. Among the topics to be discussed are inheritance of cancer in animals; virus- and carcinogen-induced mutations; inheritance of cancer in man. A number of American, Continental and British scientific workers will read papers. The meetings will be open to all interested in the subject. Further particulars can be obtained from Dr. R. R. Race, Lister Institute, Chelsea Bridge Road, S.W.1.

THE Committee of the Challenger Society has received a grant from the Development Fund to assist in paying the expenses of certain oceanographers attending joint meetings arranged by the Society. It is not available for members of State-aided institutions, nor can it be used for undergraduates. It may be used for others than members of the Challenger Society. Grants from the fund will consist of third-class travelling fare and a daily subsistence allowance. The awarding of grants rests with the Committee of the Challenger Society. The number for one meeting is likely to be limited to five or six. Applications for grants for a meeting to be held at the Fisheries Laboratory, Lowestoft, on July 8 and 9 should be submitted to the Honorary Secretary, Challenger Society, British Museum (Natural History), Cromwell Road, S.W.7, before June 15.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Anomalous Distribution of Nuclear Disintegration in Photographic Emulsions Exposed to Cosmic Rays: Double Stars

In making systematic exploration of 640 cm.² of Ilford plates of 100 μ thickness exposed vertically to cosmic rays for three to six weeks at a height of 3,600 m., we have observed 2,250 nuclear disintegrations and have noticed an anomaly in their distribution.

The accompanying table indicates the number p of observed pairs of stars for which the distance between the centres is less than R microns, the probable number P of the stars which would be observed with random distribution, and number of standard deviations r separating the observed value from the mean value.

R	50	100	150	200	250
P	0·15	1·2	5·0	10·3	17·3
p	4	10	17	24	33
r	10	8	5	4	4

For example, chance would lead one to expect 1·2 pairs with a centre distance less than 100 μ, yet we have observed 10 pairs; in this case the number of standard deviations from the mean value is 8.

The simplest explanation of the anomaly is to suppose that one of the stars of the pair has produced the other through the medium of a particle which is invisible in the emulsion (neutron, neutral meson, photon, electron, fast proton, or fast charged meson).

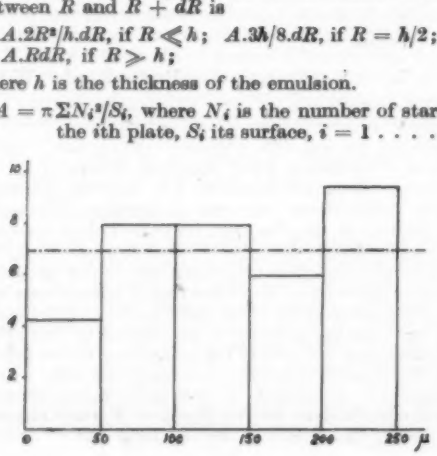
It is not possible to evaluate the energies and momenta carried by such intermediate particles from our present data, for we are unable to distinguish *a priori* a fortuitous pair from a real one; neither could we distinguish the primary star from the secondary (except three cases in which one of the stars is due to a σ-meson). Furthermore, the measurements with photographic emulsion involve many uncertainties, such as the nature of the disintegrated nucleus, nature of short tracks, distribution of emitted neutrons.

However, it is possible to get an idea of the order of magnitude of the cross-section of this intermediate particle by the following reasoning. The probable number of random pairs with their centre distance between R and $R + dR$ is

$$A.2R^2/h.dR, \text{ if } R \ll h; \quad A.3h/8.dR, \text{ if } R = h/2; \quad A.RdR, \text{ if } R \gg h;$$

where h is the thickness of the emulsion.

$A = \pi\Sigma N_i^2/S_i$, where N_i is the number of stars in the ith plate, S_i its surface, $i = 1 \ldots 30$.



If we subtract from the observed number of pairs those due to chance as calculated above, and if we take into account the pairs which are not observed since the thickness of the emulsion is very small (by multiplying the result by $k(R) = 1$ if $R \ll h$; or $2 \log 2$ if $R = h/2$; or $2R/h$ if $R \gg h$) we shall get the number of non-fortuitous double stars in an emulsion, which is now presumed to be very thick, as a function of the distance separating the centres, say, from 50 μ to 250 μ.

If we assume that each star emits on the average b particles able to produce a secondary star, we get for the order of magnitude of the cross-section

$$\sigma = \frac{1}{nM}\frac{dn}{dx} = \frac{7{\cdot}5}{b} \times 10^{-24} \text{ cm.}^2,$$

where $M = 8{\cdot}5 \times 10^{22}$ is the number of nuclei per cm.³ of emulsion; $n = 2{,}250$, b is the total number of 'asterogen' particles issuing from the stars of our plates; and $dn = 35{\cdot}75$ is the number of double stars deduced from the curve by setting $dx = 250\,\mu$.

This value of σ, for example, would be in accord with that of neutrons, for the stars emit on the average four to six protons; therefore the order of b can be assumed to be 5–10.

During the course of the present work, we have been in close touch with D. H. Perkins, whose results are given in the following letter. We thank G. P. S. Occhialini, C. F. Powell, and C. M. G. Lattes for their friendly advice concerning the method; we are indebted to T. F. Hoang, L. Jauneau, J. Stroumsa and D. Morellet of the Laboratory of the Ecole Polytechnique for their assistance in the experiments.

L. Leprince-Ringuet
J. Heidmann

Laboratoire de Physique
de l'Ecole Polytechnique,
Paris.

Measurements have been made on the surface distribution of 1,230 stars on 54 sq. in. of 100 μ *C2* plates loaded with boron, exposed for 40 days at 3,650 m. elevation. Observations on the star frequency in 1 in. × ½ in. rectangles of plate area show that, by comparison with the appropriate Poisson distribution, the stars are randomly distributed over areas of these dimensions.

The distances between forty-seven close pairs of stars have been obtained; the projection, r_p, of the separation between the star centres, in the plane of the emulsion, is $r_p^2 = x^2 + y^2$, where x and y are the differences between the surface co-ordinates of each pair. If the distribution were random, the probable number of stars, out of the total observed, within distances r_p of other stars, should be $\pi r_p^2 N.N/A$, where A is the area of plate from which the total of N stars are taken. The probable number of pairs, separated by distance r_p or less, is therefore

$$Q = \tfrac{1}{2}\pi r_p^2 \frac{N^2}{A},$$

provided $Q \ll N$.

As can be seen from the accompanying table, the observed number of pairs P is considerably greater than the expected number Q, and the ratio $(P - Q)/\sqrt{Q}$ of the observed to the expected deviations is always greater than one.

Assuming the volume distribution of stars to be uniform, the actual mean separation r between the centres of pairs can be calculated in terms of the projected separation r_p, and values of r are given in the second row of the table.

r_0 (1/100 in.) r (μ)	0·25 67	0·50 131	0·75 191	1·0 254	1·5 381	2·0 508	2·5 635	3·0 762
P	2	4	6	8	16	28	40	47
Q	0·27	1·10	2·48	4·4	9·9	17·6	27·5	39·6
$(P-Q)$	1·7	2·9	3·5	3·6	6·1	10·4	12·5	7·4
$(P-Q)/\sqrt{Q}$	3·3	2·8	2·2	1·7	1·9	2·5	2·4	1·2
$B = R/q\sigma \times 10^{24}$	0·38	0·60	0·73	0·83	0·97	1·05	1·14	1·21
$(P-Q)/B = q\sigma \times 10^{24}$	4·5	4·8	4·8	4·3	6·3	9·9	11·0	6·1

If we consider the surplus of double stars to be produced by infinitely penetrating radiation from the primary stars producing secondary stars, we can easily calculate the variation of the double stars with distance r. Let q be the number of particles from each star, σ the cross-section of each for producing a further star. Then, assuming the particles to be emitted isotropically, the number of 'doubles' with separation less than r is

$$R = NqsL \cdot \left[\frac{3d}{4} + \frac{d}{2}\log r/d\right] \text{ for } r > d$$

$$R = NqsL \cdot [r - r^3/4d] \text{ for } r < d,$$

where d is the emulsion thickness and L is the number of nuclei per c.c. of emulsion. The most accurate analysis at present available gives $L = 5{\cdot}61 \times 10^{22}$ for the boron-loaded Ilford emulsions (neglecting the hydrogen content).

Hence we obtain for a mean value

$$q\sigma \times 10^{24} = 6{\cdot}5 \pm 2{\cdot}4.$$

If the invisible secondaries are assumed to be fast neutrons, $\sigma \sim 10^{-24}$ cm.^{2} and hence $q \sim 6{\cdot}5$. This requires every star to emit about six neutrons, each with sufficient energy to produce a second disintegration. The average number of protons emitted in stars in our plates is slightly more than three, with an average energy of 10 MeV. each. Since the disintegrations must liberate roughly equal numbers of neutrons and protons, and the energy required to produce a second disintegration must be at least 30 MeV., our conclusion is that only a fraction of the secondary stars are, in fact, produced by neutrons from the primaries. In the batch of plates from which these measurements were taken, we observed only one definite case in which a disintegration liberated a charged (σ) meson giving rise to a second disintegration. Hence the number of neutral mesons emitted in the disintegrations may be quite small, and if these are responsible for the regenerative processes, we should have to postulate very large nuclear capture cross-sections.

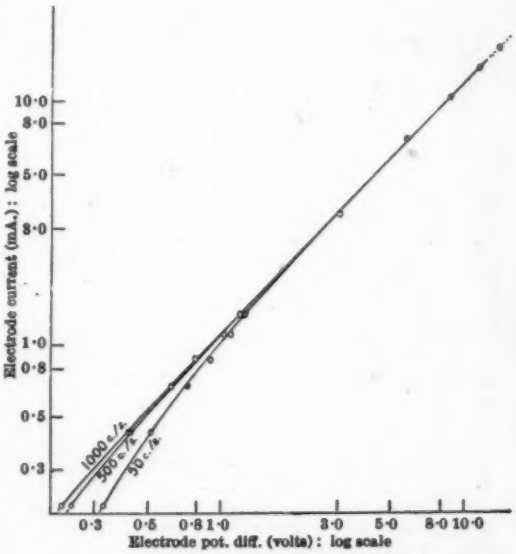
It is possible, however, that the pairs are produced by single penetrating particles, or by collimated showers of particles of unknown type. The variables in such a process could easily be chosen so as to give the observed variation of pair frequency with r.

The value of $q\sigma$ we have obtained agrees very well with that of Leprince-Ringuet and Heidmann in the previous communication. We are indebted to Prof. Leprince-Ringuet for so kindly exposing our plates in his laboratory at Chamonix, and for communicating to us his results prior to publication. Our thanks are also due to Sir George Thomson for valuable discussions and advice.

T. T. Li
D. H. Perkins
Imperial College of Science and Technology,
London, S.W.7. March 16.

An Electrolytic Tank for Exploring Potential Field Distributions

Two difficulties have commonly been experienced in the exploration of potential distributions in electrolytic tanks, when alternating current is used: (*a*) non-linear conduction due to polarization at the electrode surfaces[1], which becomes serious at very low potential differences or currents, and (*b*) corrosion of the electrodes causing the conducting path to assume a leading power factor[2], which increases with increasing current density. Both effects are greatly reduced by raising the working frequency; but they are incompatible with one another if very fine probe electrodes are used. The effect of frequency on the non-linear conduction is illustrated in the accompanying diagram.



In a series of studies using solutions of copper sulphate in distilled water of concentration varied between 0·5 and 8·0 gm./litre and copper electrodes of various diameters, we have found that very accurate results are obtained with a measuring frequency of 1,000 c./s. and electrodes 0·5 mm. diameter, provided that the current per electrode is not less than 5 mA. or the current density does not exceed 0·2 mA./sq. mm. (by adjusting electrode depth). These results apply throughout the range of concentration quoted.

For such fine electrodes, steel sewing needles which have previously been plated by the copper cyanide process, being rigid, are particularly suitable. The current density used during the plating process has been 0·3 mA./sq. mm. for the first 5 min. and 0·015 mA./sq. mm. for a further 20 hours. This affords a polished copper surface 0·04 mm. thick. The plated needles have then been immersed in boiling acidified copper sulphate solution for a few minutes to coarsen and stabilize the copper crystals.

Alongside these studies, attention has been given to removal of errors due to the finite tank boundary, which can limit seriously the usable fraction of the electrolyte surface. A circular shallow tank, 18 in.

diameter, has been used, divided into two equal layers $\frac{1}{4}$ in. deep, by a glass disk held at half the depth of the electrolyte. The top liquid layer, in which the potential field to be explored is set up, is thus contiguous with the lower layer around the periphery and may be shown to be electrically 'matched', such that it simulates an infinite sheet of electrolyte. The measured error in potential at the extreme edge is less than $\frac{1}{4}$ per cent.

Thanks are due to the Electro-Chemistry and Chemical Engineering Departments of this College for assistance and advice.

R. MAKAR
A. R. BOOTHROYD
E. C. CHERRY
Electrical Engineering Department,
Imperial College, London, S.W.7.
Feb. 16.

[1] Rollet, A. P., *C.R. Acad. Sci., Paris*, **185**, 457 (1927).
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Electron Emission from Oxide-coated Cathodes under Electron Bombardment

THE electron emission from thermionic cathodes of the alkaline-earth oxide-coated type when under electron bombardment has been investigated recently by Johnson[1] and by Pomerantz[2]. Johnson concluded that the secondary-electron emission produced by the bombardment changed little with the cathode temperature, that at 850° C. the maximum value, δ_m, of the secondary to primary ratio was about 5, and that the bombardment produced a temporary improvement in the thermionic activity of the cathode, which gave an 'enhanced thermionic emission'. Pomerantz, on the other hand, concluded that the secondary-electron emission increased exponentially with the cathode temperature, and deduced from extrapolation of the results obtained at lower temperatures that, at 850° C., δ_m exceeded 100. The effect which Johnson interpreted as "enhanced thermionic emission" was also observed; but that interpretation was not accepted. It has been suggested[3] that "enhanced thermionic emission" rather than secondary-electron emission enables the anode current in a magnetron to exceed the thermionic emission provided by the unbombarded cathode. The experiments the results of which are indicated below were designed to throw light on the disagreement in the conclusions of the above investigators regarding the temperature dependence of the secondary-electron emission, and on the nature of the "enhanced thermionic emission" effect.

The target cathodes used in the experiments were coated with various thicknesses of a standard barium–strontium carbonate coating mixture. The measurements were made in electron-gun type tubes, the primary electrons being focused on the target through a hole in the collector surrounding the target. The secondary-electron yield of each target was measured as a function of the energy of the bombarding electrons, of the thermionic activity of the target, of coating thickness, and of target temperature in the range 20°–850° C. At temperatures at which thermionic emission was appreciable, both the thermionic emission and the emission caused by the bombardment were collected by pulsed collector voltages, pulses of 5–100 microsec. duration being used. In respect of the pulsed collection of the thermionic emission, and in the use of high collecting voltages (up to 5 kV.), the measurements differed from those made by other investigators.

The experiments showed that the secondary-electron yield of the various targets when at room temperature increased with the energy V_P of the primary electrons, reached unity at V_P 35 ± 5 eV. and a maximum value δ_m at V_P 1,100 ± 100 eV. δ_m varied from target to target, and values as low as 4 and as high as 14 were observed. When the targets were heated, δ_m usually changed to some extent in the lower temperature range, but in the temperature range, up to 850° C., in which the thermionic emission was appreciable, all the targets gave values of δ_m between 5 and 10 independent of the temperature. Incidentally, targets coated by evaporation in vacuum, and on which the coatings were so thin that they appeared merely as tarnishings of the nickel bases, gave δ_m values of about 4 or 5 which were completely independent of target temperature in the range investigated, 20°–850° C.

The results obtained with target coatings of various thicknesses and of varying degrees of activation supported the view that the variation of δ_m with temperature in the lower temperature range was not of a fundamental nature but was due to disturbing effects resulting from the appreciable resistance of the coating at those temperatures. On this view it would appear that Pomerantz was not justified in extrapolating from the yield values he obtained at the lower temperatures in order to deduce yield values at temperatures about 850° C., for the cause of the variation at the lower temperatures would have had negligible effect at the higher temperatures.

No evidence was obtained of the effect which Johnson interpreted as "enhanced thermionic emission". The electron current released from each target by a given pulsed bombardment rose immediately (in less than a microsecond) to a value which remained constant during the bombardment and dropped to zero immediately after the bombardment, and the magnitude of this current changed little with the target temperature. It is possible that the effect observed by both Johnson and Pomerantz followed from the continuous collection of the thermionic emission from the targets in their experiments. Continuous collection of thermionic emission from an oxide cathode is known to lower its thermionic activity, partly through increasing the concentration of 'foreign' atoms on the surface. Reduction of this concentration by the bombardment could then cause enhancement of the thermionic emission. Another reason for the absence of the effect in the present experiments might have been the adequate elimination of disturbing space-charges by the high collecting voltages that were used.

Thanks are due to Mr. A. Sczaniecki for his help in one of the experiments. A fuller account of the investigations will be published elsewhere. The work was done at the Admiralty Signal and Radar Establishment, and permission to publish this communication is gratefully acknowledged.

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Total Emission Damping

In recent letters in *Nature*, C. N. Smyth[1], A. van der Ziel[2] and A. van der Ziel and A. Versnel[3] have reported measurements on the damping produced by a diode in the non-conducting state placed across a resonant circuit.

To investigate this subject mathematically, the following idealization has been employed. It is assumed that the thermionic electrons are all emitted with speed v_0 at right angles to the cathode surface, and that they are then acted upon by a constant retarding field E_R superimposed upon the small alternating field $E_S \sin(\omega t + \varphi)$. The time of flight of these electrons in the absence of the alternating field is then $2v_0/E_R\frac{e}{m} = T$, and the transit angle is $\theta = \omega T$. If E_S is small compared with E_R, it can then be shown that the damping conductance $1/R$ is given by

$$\frac{1}{R} = \frac{8V_0I}{V_R^2} f(\theta). \qquad (1)$$

In this equation V_0I is total power emitted by the cathode, that is, the product of the number of electrons emitted per second and the kinetic energy of each electron. V_R is E_RD, where D is the effective distance across which the constant fields E_R and E_S are assumed to act.

The interesting part of equation (1) is $f(\theta)$, which is

$$f(\theta) = \frac{1}{\theta^2}\left[\left(1 - \frac{1}{\theta^2}\right)\{4(1 - \cos\theta) - 4\theta \sin\theta + \theta^2(1 + \cos\theta)\} + \{2(1 - \cos\theta) - \theta\sin\theta)\}\right]. \qquad (2)$$

This may be compared with the corresponding function for the conducting diode, $F(\theta)$, where

$$F(\theta) = \frac{1}{\theta^2}[2(1 - \cos\theta) - \theta\sin\theta]. \qquad (3)$$

Graphs of $f(\theta)$ and $F(\theta)$ are shown in Fig. 1.

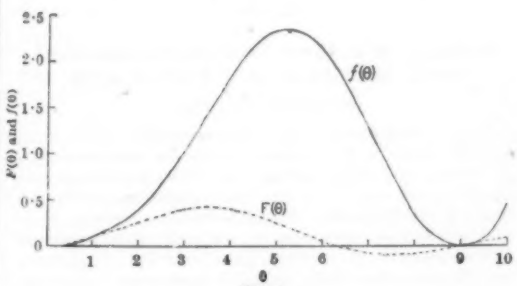

Fig. 1

That the absolute magnitude of the damping in equation (1) can be of the correct order of magnitude may be shown as follows. In Smyth's case[1], assume the values $V_R = 1$, $V_0 = 1/16$, both in volts, and $I = 1/10$ amp. per cm.^{2}. Then equation (1) gives $R = 20$ ohms per cm.^{2}. In van der Ziel's case[2], the damping is so small and the cathode-anode spacing is so large that it would be unwise to guess the value of V_R.

An interesting point emerges if equation (1) is written in the correct form to exhibit the variation of the damping with V_R, where V_R is assumed to be proportional to $1/\theta$. Then

$$\frac{1}{R} = \frac{I}{(\omega D)^2}\theta^2 f(\theta) = \frac{I}{(\omega D)^2}\frac{\theta^4}{9}$$

for small values of θ. The function $\theta^2 f(\theta)$ is shown in Fig. 2.

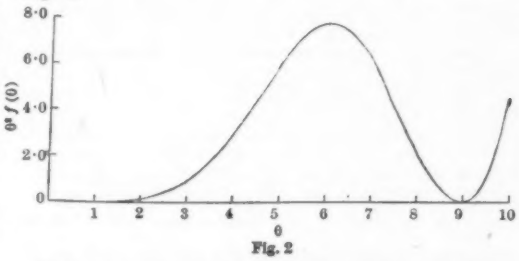

Fig. 2

It is not suggested that the idealization which has led to the results reported above is adequate to explain all the phenomena of total emission damping; but it points to a mode of attack on the problem which is hopeful. The method by which equations (1) and (2) are derived will be published elsewhere in due course.

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Theory of the Streaming Potential

Booth[1] has recently pointed out the unsatisfactory nature of the existing theory of electrokinetics, and suggested modifications to the commonly used equations of Helmholtz[2] and Smoluchowski[3], with particular reference to the phenomenon of electrophoresis. I have devoted some attention to the theory of the streaming potential difference set up in the plane of flow when an electrical double layer, existing at an immobile interface in an ionic liquid, is sheared. This potential difference will tend to resist the flow of the liquid owing to the electrical retarding force acting on the ions of the double layer. It has been shown[4,5] that in narrow channels this electrical resistance to flow, or 'electroviscous resistance', can assume considerable importance, with the result that the apparent viscosity of a liquid in such channels may be increased several fold, depending on the values of the electrokinetic potential of the double layer, the specific conductivity of the liquid in the channel, and the dielectric constant. Various workers[6–8] have reported the qualitative observation of such an effect, and a quantitative experimental examination of the subject has been commenced in this laboratory.

In view of this apparent increase in viscosity in narrow channels, it is to be expected that zeta-potentials calculated from measurements made in diaphragms of very small particle size will lead to anomalously low results if the usual Helmholtz–Smoluchowski equation is used. The results of Bull and Gortner[9] and others[10–12] have been explained on this basis[4,5].

The results of this analysis are of importance when applied to the theories of surface conductivity and of lyophobic colloid stability, and offer an explanation of certain anomalous results obtained by workers[13–15]

who attempted to measure equilibrium distances of separation between surfaces immersed in ionic liquids.

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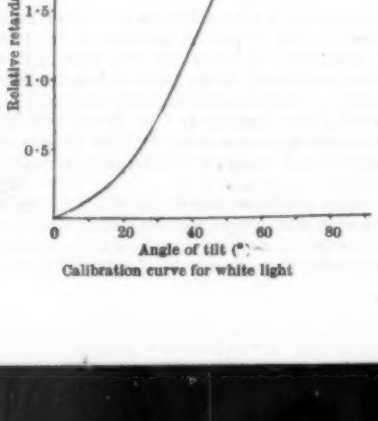
A Large Field Compensator of the Berek Type

P. E. Jellyman and A. J. Milne have described in *Nature* of March 27, p. 477, a form of photo-elastic compensator using a plate of *C.R.*39 resin in which a uniform stress variation (produced by pure bending) is frozen. A more sensitive compensator (which also depends on the frozen stress in *C.R.*39 resin) has been in use for more than a year at the Royal Aircraft Establishment. This instrument works on the same principle as the Berek compensator, in which a thin crystal slice (calcite or quartz), cut normal to the optic axis, can be tilted at various angles to the light path, giving a relative retardation increasing with the angle of tilt.

The Berek instrument is used in conjunction with a polarizing microscope. For covering fields of several inches diameter, natural crystals sufficiently large are not to be had. Instead, I have employed a plate of *C.R.*39, $\frac{3}{4}$ in. thick by about 4 in. by $2\frac{1}{2}$ in.

In the process of manufacture, the applied lateral pressure produces a frozen stress in a direction normal to the plate. This stress is not always uniform, but the piece selected had a variation of less than 3 per cent over its whole area. The *C.R.*39 sheet, which has uniform thickness, high polish and excellent light transmission, is lightly held between two frames mounted symmetrically on co-axial spindles which can rotate in a circular frame. The angle of rotation is shown by a pointer and scale. The whole frame is a sliding rotational fit in a split outer ring which is provided with an angular scale. Thus the axis of tilt can be adjusted to lie in the direction of either of the principal stresses. The inner ring is then fixed by the clamping screw. The instrument is set for compensation, and the plate is then tilted by means of a knurled knob; it can be clamped in any position. Owing to the large area of the plate it is rarely necessary to adjust the position of the instrument in the light field (except perhaps when the angle of tilt is high and the projected area is reduced).



Calibration curve for white light

One advantage of this type of instrument is that its sensitivity becomes greater for very small retardations, as is shown by the accompanying calibration curve. For a crystal slice, the slope of the curve would increase continuously. In the *C.R.*39 instrument, the slope appears to become constant. This may be due to the fact that the birefringence is not completely constant through the thickness of the material. The instrument may be calibrated directly in Angström units if desired. The calibration has stayed constant for more than a year, and is not noticeably affected by slow temperature variations in the laboratory. It is necessary, of course, to avoid stresses due to clamping.

The range of the instrument is from 0 to 3 fringes (at about 69° angle of tilt), and its sensitivity 1/20 fringe or better. The calibration can be readily checked at any time.

When used, the instrument is mounted on the photo-elastic bench between the polarizer and the model, so as to avoid displacement of the image as a result of tilting.

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Isolation of a New Androstenol-3(α)-on-17 from the Urine of a Patient with Adrenal Cancer

In a previous paper (Dingemanse, Huis in 't Veld and De Laat[1]), we reported that we had detected, by means of a chromatographic-colorimetric method, a new 17-ketosteroid in the urine of patients suffering from a dysfunction of the adrenal cortex. This 17-ketosteroid, to which we refer in this paper as 17-ketosteroid II, occurs in the urine of normal individuals, as a rule, in small quantities only, and may be completely absent. Considerable amounts, however, have been found in the urine of persons with 'virilizing' tumours and with hyperplasias of the adrenal cortex.

This substance has now been isolated from the urine, and obtained in pure condition. We used for this purpose 2 litres of urine of a female child aged two, who showed symptoms of virilism, and from whom afterwards an adrenal tumour was extirpated.

The urine was neutralized and extracted according to the method of Dingemanse and Laqueur[2], and the extract was purified by means of chromatographic analysis and high-vacuum sublimation. After re-

peated crystallization from a watery methanol solution and from petroleum ether, a product with a melting point of 140·5–141° C. was obtained. In ethanol its specific rotation was found to be $+121 \pm 3°$.

The quantitative analysis led to the empirical formula $C_{19}H_{18}O_2$ (H, 9·68; C, 79·06 per cent). In 80 per cent ethanol it gave no precipitate with digitonin. Titration, by the method of Rosenmund – Kuhnhenn, revealed the presence of one double bond (1·89 and 2·14 equivalents of bromine were taken up). With hydroxylamine it was found to form a monoxime with a melting point of 109–113° C. (N, 4·40 per cent). An acetate could not be isolated in the pure condition. The α-ketosteroids are, as is well known, more difficult to esterize than the β-ketosteroids.

The new ketosteroid proved to be unstable in the presence of mineral acids. When treated at room temperature with hydrochloric acid, it formed two transformation products that could be separated by chromatographic analysis. The first proved to have a melting point of 151–152° C., and the quantitative analysis led to the empirical formula $C_{19}H_{17}OCl$ (C, 74·44; H, 8·83; Cl, 11·53 per cent).

The second transformation product had a melting point of 140–141° C., and gave a precipitate with digitonin. When this substance was mixed with dehydro-*iso*-androsterone, the melting point underwent no change. Its acetate proved to have a melting point of 171–172° C.; mixing with dehydro-*iso*-androsterone acetate did not lower the melting point. We must assume, therefore, that it is identical with Δ5-androstenol-3(β)-on-17 (that is, dehydro-*iso*-androsterone).

Our idea of the reaction with hydrochloric acid is that it takes place as follows:

17-ketosteroid II $\xrightarrow{HCl}$ chloro-ketone $\xrightarrow{HCl}$ dehydro-*iso*-androsterone.

Dehydro-*iso*-androsterone is *not* appreciably transformed in a chloroketone when it is treated at room temperature with hydrochloric acid. Butenandt[3,4] has already pointed out in a paper on the chloroketone of male urine that the precursor of this compound may be different from dehydro-*iso*-androsterone.

The configuration of 17-ketosteroid II must therefore be very similar to that of dehydro-*iso*-androsterone. For this reason it seems to us that the atom C_3 will bear an α-hydroxyl group. For a keto group at C_{17} the Zimmermann reaction is characteristic. The Pincus reaction of 17-ketosteroid II is qualitatively as well as quantitatively the same as that of dehydro-*iso*-androsterone.

On account of the fact that 17-ketosteroid II is transformed by the action of hydrochloric acid in dehydro-*iso*-androsterone, there are apparently three positions in which the double-bond might, theoretically, be present; namely, Δ4.5, Δ5.6 and Δ6.7. Ruzicka and Goldberg[5] have synthesized the Δ5.6-androstenol-3(α)-on-17, which proved to have a melting point of 221° C., and $[\alpha]_D \sim 0°$. Our new ketosteroid, therefore, cannot be identical with this substance.

As the formula Δ4.5-androstenol-3(α)-on-17 accounts better than the other ones for the instability of our substance in the presence of acids (Wolfe, Fieser and Friedgood[6]), this configuration seems to be the most plausible. Wolfe *et al.* have already pointed out that this ketosteroid might be found in urine extracts.

We have tried to ascertain the configuration of 17-ketosteroid II by oxidation, using Oppenauer's method, of the hydroxyl group attached to C_3. If the formula suggested above be correct, this ought to give Δ4.5-androstenedione. The melting point of our oxidation product proved, however, to be 185° C., and is therefore different from the melting points that have been reported for Δ4.5-androstenedione. Mixed with Δ4.5-androstenedione it showed, moreover, a sharp fall in its melting point.

The possibility that our 17-ketosteroid II might be an *i*-steroid was also considered. *I*-steroids are so far known only as synthetic products (Wallis, Fernholz and Gephart[7]). When a surplus of bromine is added, such substances ought to give tribromides (Beyon, Heilbron and Spring[8]; Wallis *et al.*[7]), whereas our product absorbed in the Rosenmund – Kuhnhenn titration but two equivalents of bromine

The investigation is being continued.

The quantitative analyses were carried out by Mr. P. Hubers in the Laboratory for Organic Chemistry of the Amsterdam Municipal University. A grant was received for this study from Organon, Ltd., Oss.

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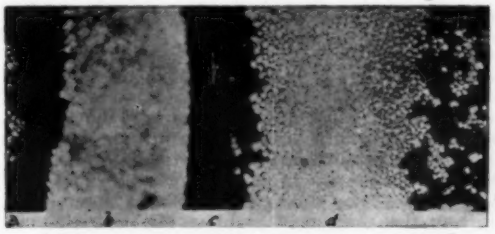
Evidence for an Electrostatic Field on Penicillin Assay Plates

ONE of the effects of penicillin on susceptible bacteria is to cause a change in electrostatic charge which may be measured in terms of ζ potentials, and which it has been suggested may be used quantitatively for assaying solutions of penicillin[1,2,3]. So early as 1938, Loiseleur[4] studied changes that occur in electrostatic charge during proteolysis, such as would be expected during lysis of bacterial cells. Similar changes in charge resulting in development of an electrostatic field can be shown on penicillin assay plates by treatment with electronegative or electropositive colloids suspended in buffers at *p*H levels above or below the isoelectric range of the nucleoproteins.

The accompanying reproduction is of a photomicrograph of a segment of an inhibition zone on a standard assay plate that was flooded for a few minutes with a suspension of starch in phosphate



SEGMENT OF AN INHIBITION ZONE SHOWING FLOCCULATION OF STARCH WITHIN ZONE

buffer (*p*H 6·8) and from which the excess suspension was afterwards decanted. It shows (*a*) a few scattered starch grains at the site of the buffered penicillin solution inside the 'penicylinder'; (*b*) starch grains sedimented in the trough, where the 'penicylinder' had rested (out of focus because in a different plane from the surface of the agar); (*c*) a narrow ring devoid of starch around the trough; and (*d*) the circumjacent wide band of starch grains covering most of the width of the inhibition zone and extending up to the 'ring of enhanced growth' where a few scattered grains appear on the right.

Conversely, the 'ring of enhanced growth', where starch fails to flocculate, is the site of heaviest deposition of silver following flooding of the plates with an aqueous solution of silver nitrate[4,5], or of the red triphenyl formazan following treatment with solutions of triphenyl tetrazolium chloride such as have been used as indicators of seed viability[7,8].

These observations may be taken as evidence of electro-negativity in the regions of enhanced growth and of positive charges in the zones of inhibition. No such responses are seen on unseeded plates exposed to penicillin. Thus the effects cannot be attributed to reactions of the reagents with penicillin diffusing from the cylinders.

The *p*H effect postulated by Carr[9] to account for the mechanism of the Feulgen reaction may be demonstrated by comparing plates stained with basic fuchsin at *p*H values above 6·2 or below 4·8. The more acid solutions stain the colonies in the background intensely red, thus sharply outlining the unstained inhibition zones, from which the desoxyribose nucleic compounds have been dispersed. There is relatively poor definition of the zones on plates stained with the less acid solutions.

Grateful acknowledgment is made to the Cutter Laboratories, Berkeley, California, for partial support of these experiments.

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Fœtal Hæmoglobin and Erythroblastosis

THE hæmoglobin of the fœtus and the new-born child and the hæmoglobin of older children and adult people can be distinguished by their different resistance against 0·1 *N* sodium hydroxide. At *p*H 12 normal hæmoglobin is denatured very rapidly, whereas fœtal hæmoglobin is denatured only slowly. By using this difference in denaturating-rate, it is possible to calculate the amounts of fœtal and later hæmoglobin present in small samples of blood[1]. A normal new-born child has only fœtal hæmoglobin. During the early months after birth, this hæmoglobin is gradually replaced by later hæmoglobin, at a rate of a little less than 1 per cent a day, so that after 120 days normally all fœtal hæmoglobin has disappeared. In prematurely born babies, later hæmoglobin appears only at the time that the child ought to have been born[2].

In new-born children suffering from erythroblastosis fœtalis caused by the *Rh* antagonism there is a marked difference in behaviour of the two hæmoglobins. The fœtal hæmoglobin is broken down very rapidly, so that in severe cases it has practically disappeared from the blood within about five days. In less severe cases the breakdown stops after about six days and a certain amount of the fœtal hæmoglobin remains. This remaining fœtal hæmoglobin disappears during succeeding months as it does in normal children. On the other hand, later hæmoglobin normally not found in the blood shortly after birth is already present in these patients at the moment of delivery. It is present in an amount up to 4 gm. per 100 c.c. of blood. This later hæmoglobin is not broken down, or only very slowly, during the serious hæmolysis, the fœtal hæmoglobin being broken down rapidly. When the child survives, its amount rises slowly later on. The *Rh* antibodies which are the cause of the destruction of the red blood corpuscles and of the hæmoglobin have not the same action on the cells containing fœtal and later hæmoglobin respectively. Only those which contain fœtal hæmoglobin are hæmolysed.

The presence in the blood at the moment of birth of later hæmoglobin, which is not broken down in children suffering from erythroblastosis, must be the result of a reaction of the child before birth against the *Rh* antibodies of the mother.

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Action of Sulphuryl Chloride on Wool

ONE of several general methods of making wool unshrinkable depends for its success on disulphide-bond breakdown in the surface of the fibres. A solution of sulphuryl chloride in white spirit is sometimes used for this purpose[1]; but it has now been found that treatment which is effective with commercial fabric is relatively ineffective when the latter is freed from adsorbed soap and residual oil by extraction with alcohol and ether.

Samples of extracted and unextracted flannel (2·5 gm.) were conditioned at 65 per cent relative humidity and 22·2° C. before being immersed in 100 c.c. of a 2·5 per cent (v./v.) solution of sulphuryl chloride in carbon tetrachloride for one hour at room temperature. After treatment, the samples were neutralized with sodium bicarbonate solution, washed in running water, and then milled by hand for fifteen minutes in 5 per cent soap solution. The resulting shrinkages are given in Table 1, which includes data for an extracted sample to which 0·5 per cent by weight of oleic acid (I.V. 83·7) had been added before treatment with sulphuryl chloride.

TABLE 1

Fabric	Treatment	Percentage shrinkage in area
Extracted	None	42·7
Unextracted	Sulphuryl chloride	3·2
Extracted	,, ,,	25·0
Extracted + oleic acid	,, ,,	−7·3

Similar results were obtained with white spirit as the solvent, and the effect of oleic acid in promoting the reaction between wool and sulphuryl chloride is remarkable. When, however, oleic acid is added to the solution of sulphuryl chloride in carbon tetrachloride, instead of to the wool, no beneficial effect is obtained, as is shown by the data of Table 2.

TABLE 2

Fabric	Treatment	Percentage shrinkage in area
Extracted	None	43·7
Extracted	Sulphuryl chloride	24·0
Extracted + oleic acid*	"	−5·0
Extracted	Oleic acid* + sulphuryl chloride	24·6

* 1 per cent on the weight of the wool.

Further, the action of oleic acid in assisting the reaction is not entirely lost when the fabric to which 1 per cent of oleic acid has been added is left in carbon tetrachloride for periods up to two hours, or is washed in three changes of carbon tetrachloride over a period of one hour, before adding sulphuryl chloride.

The most probable explanation of these results is one based on the work of Kharasch and Brown[2]. If peroxides in the oleic acid are adsorbed by the wool, they will promote the formation of free chlorine atoms at the wool-solution interface:

$$R\cdot + SO_2Cl_2 \rightarrow RCl + SO_2 + Cl\cdot.$$

The chlorine atom may then react with the disulphide bond of wool:

$$R\text{—}S\text{—}S\text{—}R + Cl\cdot \rightarrow R\text{—}SCl + R\text{—}S\cdot.$$

$$R\text{—}S\cdot + SO_2Cl_2 \rightarrow R\text{—}SCl + SO_2 + \cdot Cl,$$

and so on, thus causing unshrinkability. When, however, oleic acid is dissolved in carbon tetrachloride, instead of being applied to the wool, free chlorine atoms are more easily lost by reaction with the oleic acid itself. In support of this explanation, it should be added that stearic acid (I.V. 5·2) has little catalytic effect on the reaction between sulphuryl chloride and wool.

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Demonstration and Separation of Noradrenaline, Adrenaline and Methyladrenaline

A simple and reliable means of recognizing noradrenaline, adrenaline and methyladrenaline, singly or in mixtures, has been obtained by combining two methods: one enzymatic and the other chromatographic.

Enzymatic. An insoluble polyphenolase is prepared from shoots or roots of *Atropa belladonna* by blending twice with acetone and discarding the fluid. The solid residue is extracted three times with water, and further washings should give no colour reaction with ninhydrin. The residue is dried at room temperature and ground to a 60-mesh powder. It can be stored in a stoppered bottle without loss of activity for several months. Dried belladonna leaf is obtainable from manufacturing chemists, and, if retaining a green colour, contains active enzyme.

For the test, a few drops of solution containing not less than about 20 μgm. of the adrenaline are diluted in a test-tube with 2 ml. phosphate buffer, *p*H 7·8. About 50 mgm. enzyme (the exact amount is immaterial) is added and shaken into a suspension. The tube is kept at 30° C. for ten minutes and the colour is then observed. If adrenaline was present it will be bright orange-red (adrenochrome) and, if noradrenaline was present, pale brown. The adrenochrome is stable in solution for several hours and then slowly fades. The brown coloration is due to condensation products of noradrenochrome which are precipitated in a dark layer at the bottom of the tube. Under the conditions described, the bright red colour of noradrenochrome is never visible, and no confusion can occur. If inorganic oxidizers are used, this colour appears strongly at first and no easy distinction from adrenachrome is possible. Methyladrenaline gives no colour reaction.

The reactions of several related polyphenols have been observed; the primary amines tend to resemble noradrenaline and the secondary amines resemble adrenaline. Thus, 3,4-dihydroxytyramine gives no detectable red stage; 'Dopa' gives a transient pink stage which passes rapidly to brown and then to a black precipitate easily distinguished from the noradrenaline brown. Corbasil gives a temporary red colour which passes over to brown; it is distinguished from noradrenaline by the red phase and from adrenaline by the brown. Among the secondary amines, epinine and N-methylcorbasil give a red that is much less stable than adrenochrome and fades within the hour. There is no difficulty after one trial with known solutions in distinguishing any of these changes from those due to noradrenaline and adrenaline. In a mixture of noradrenaline and adrenaline, a pale brown colour develops first and is followed by a stable red colour, a sequence that is not obtained with any one substance.

Chromatographic. A good separation of the adrenalines is obtained on a Whatman No. 1 paper chromatogram, using the one-way method of Consden, Gordon and Martin[1] with phenol as solvent. The amines are applied as hydrochlorides from neutral or slightly acid solution. In this state they are stable in air and not destroyed by heating to about 100° C. when driving off the phenol. Potassium ferricyanide, made up to 0·44 per cent in phosphate buffer *p*H 7·8, is used as indicator. Oxidation of the adrenalines is immediate and leads to a brownish-red spot with noradrenaline and a bright red spot with adrenaline. Methyladrenaline does not give a colour when oxidized, since no indole ring-closure is possible; but the ferricyanide is bleached by reduction so that a white spot is left on the paper that does not turn yellow until a considerable excess of ferricyanide is applied. As soon as the white spot is defined, the presence of methyladrenaline may be confirmed by adding one drop of very dilute copper sulphate. A red colour (due to ferrocyanide) is given, whereas the surrounding ferricyanide, in the absence of a reducer, gives a brown. The highly sensitive arsenophosphotungstate blue, sometimes used for detecting the adrenalines, is not suitable as an indicator, since it is produced by reduction of the reagent on the surface of the paper itself. Ninhydrin gives a strong

coloration with noradrenaline, but a very weak one with adrenaline. It sometimes affords useful confirmation for the former if interfering amino-acids are not present.

So far, no second solvent has been found in addition to phenol that will separate the adrenalines. Very little movement occurred in *n*-butanol and none in collidine, amylacetate or butyric acid. All runs have been for approximately twenty hours at room temperature, and the R_F values observed were as follows :

Noradrenaline	$(HO)_2$ ♀ $CHOH.CH_2.NH_2$	0·216
'Dopa'	$(HO)_2$ ♀ $CH_2.CH.COOH.NH_2$	0·230
3,4-Dihydroxytyramine	$(HO)_2$ ♀ $CH_2.CH_2.NH_2$	0·320
Corbasil	$(HO)_2$ ♀ $CHOH.CH.Me.NH_2$	0·408
Adrenaline	$(HO)_2$ ♀ $CHOH.CH_2NH.Me$	0·441
N-methylcorbasil	$(HO)_2$ ♀ $CHOH.CH.Me.NH.Me$	0·706
Epinine	$(HO)_2$ ♀ $CH_2.CH_2.NH.Me$	0·760
Methyladrenaline	$(HO)_2$ ♀ $CHOH.CH_2.NMe_2$	0·796

It will be seen that the movement of these substances in phenol is determined mainly by the terminal amine group and that the R_F increases as this is methylated. An ideal separation is consequently achieved between the three adrenalines. Taking the list as a whole, satisfactory separation in a mixture cannot be guaranteed if the difference of R_F values falls much below 0·1. The confusion most likely to matter in tissue extracts is that between noradrenaline and 'Dopa'. This is easily resolved by the enzyme test, because of the black colour given by 'Dopa'. Adrenaline can be distinguished from corbasil with a similar R_F by the much greater stability of adrenochrome over the corresponding corbasil derivative in the enzyme tests.

These methods have been successfully applied to the demonstration of noradrenaline and adrenaline in tissue extracts. I am indebted to Dr. H. Blaschko for samples of most of the compounds used.

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Association of Xanthine Oxidase with Virus Multiplication

It has previously been reported that the xanthine oxidase content of mouse brain is markedly increased during infection with yellow fever and other viruses[1,2], and evidence was adduced which suggested that this rise of enzyme activity was not fortuitous but was causally related to the growth of virus in the tissue. The possibility of the virus particles themselves having xanthine oxidase activity was excluded by the demonstrable lack of parallelism between enzyme activity and the amount of virus in the brain. Recent work reported here shows that the extra enzyme is not obtained from other parts of the body, and demonstrates that synthesis of xanthine oxidase takes place during virus infection.

Fertile eggs at the ninth day of incubation were inoculated with the 17 *D* strain of yellow fever virus by the allantoic route, and were then incubated for a further period. In a preliminary survey of the enzyme activity of the various tissues of both normal and virus-infected eggs, it was found that xanthine oxidase was present only in the chorioallantois and

○, NORMAL EMBRYOS; ●, EMBRYOS INFECTED WITH 17 *D* STRAIN OF YELLOW FEVER VIRUS

the embryo. In all subsequent experiments the embryo and membrane were ground up together with twice the weight of water and centrifuged, and the supernatant fluid was tested for xanthine oxidase activity by the Thunberg technique. The enzyme activity of the combined tissue extract was expressed in arbitrary figures per unit weight of tissue. The results are shown in the accompanying graph. The values for normal embryos remain fairly constant throughout the period of incubation investigated; since the weight of the embryo increases from 1 to 20 gm. over this period, a continual synthesis of xanthine oxidase must be taking place of sufficient extent to maintain a uniform value per unit weight of tissue. The values for embryos infected with virus are in nearly all cases considerably higher than normal, the increase being particularly noticeable on the thirteenth day; between the thirteenth and eighteenth days the activity falls towards the normal level. Since these determinations were all made upon the embryo plus the chorioallantoic membrane, which together represent the only available source of xanthine oxidase, it is evident that the enzyme content of the whole egg is increased in response to the virus infection, and that the possibility of enzyme accumulating in infected tissues from depots elsewhere can be excluded. In addition to the synthesis of xanthine oxidase which is taking place in the normal embryo, there is thus an additional synthesis brought about by the presence of the virus, and it is suggested that this extra amount of enzyme is required for virus metabolism.

There are certain points to be noted in comparing these results with those already reported for mouse encephalitis. (1) In the chick embryo there is very little cellular response to the presence of the virus, so that the rise of enzyme activity is not likely to be due to the presence of a round-cell infiltration. (2) The maximum enzyme activity (0·44) is lower than that found in mouse brain (1·6), which may be related to the lower virus titre (10^4 in the embryo and 10^7 in the mouse brain). (3) The virus titre and enzyme activity both fall from the thirteenth day onwards, and a similar fall of enzyme activity is seen in mouse encephalitis after the onset of symptoms and attainment of maximum virus titre; these facts suggest that enzyme synthesis is connected with the active proliferation of virus and occurs only during this phase.

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[1] Bauer, D. J., *Nature*, **159**, 438 (1947).
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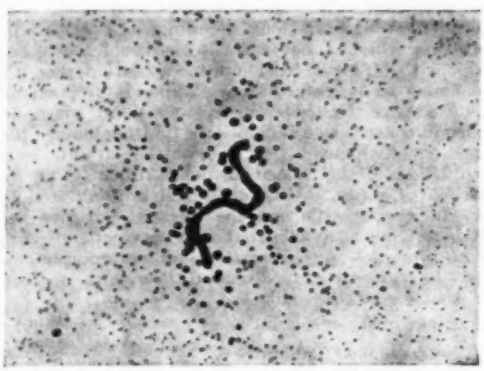
Unsaturated Fatty Acids in Cotton Wool Plugs

DURING a study of a diphtheroid bacterium (not yet identified, but temporarily labelled *Q*) it has been found that the slight growth on nutrient agar can be abolished by adding 0·2 per cent charcoal to the agar. Growth on charcoal-agar could be restored by adding excess of oleic, linoleic or linolenic acids. Experiments in synthetic media showed that the organism requires these unsaturated fatty acids as growth factors.

It was noted that 'satellitism' of colonies of *Q* occurred on charcoal-agar plates around a fibre of cotton wool accidentally dropped on the surface (see accompanying illustration). It appeared that the cotton fibre was supplying the necessary fatty acid growth-factor. 20 gm. of the ordinary non-absorbent cotton wool used in the laboratory for plugging all sterile glassware were therefore extracted for 3 hr. in a soxhlet with methanol, yielding 24·7 mgm. (more than 0·12 per cent) of petrol-soluble lipoid.



GROWTH STIMULATION, BY A COTTON FIBRE, OF MICRO-COLONIES OF A BACTERIUM (Q) REQUIRING OLEIC ACID; MEDIUM NUTRIENT AGAR CONTAINING 0·2 PER CENT CHARCOAL. × 25

This phenomenon was at once linked with the observation that a greasy film developed on the inside of flasks and tubes, previously acid-cleaned, plugged with cotton wool and sterilized by treatment for 1½ hr. in the oven at 180°. This greasy film, which was itself invisible, was only detected because it rendered the surface of the glass completely hydrophobic. It did not appear when plugs made of the extracted cotton wool were used. The bacteriostatic properties of the fatty distillate from cotton wool plugs has previously been reported by Wright[1] for pneumococci and by Drea[2] for tubercle bacilli, but the importance of their observations has not perhaps been fully appreciated.

When the fat-extracted cotton wool was used for plugging flasks in experiments with *Q*, the organism completely failed to grow in the absence of oleate; whereas previously, with ordinary plugs, quite considerable, though variable, growth had occurred in the basal synthetic medium alone.

It was thus possible, using *Q* as the test organism, to make a rough assay of the growth-promoting activity of the fatty extract from cotton wool, which was found to be 25–50 per cent that of oleic acid. (It should be mentioned here that pure linoleic and linolenic acids have exactly the same growth-promoting activity for *Q* as oleic acid, while the two saturated acids, palmitic and stearic, are quite inactive.) It was calculated that each cotton wool plug contained 0·5–1·0 mgm. of oleate-equivalent lipoid. Further, by measuring the average growth of *Q* in 5 ml. of basal medium without oleate in 50 ml. flasks plugged with ordinary cotton wool and sterilized in the usual way by hot air at 180° for 1½ hr., the oleate-equivalent quantity of lipoid distilled off the plugs and afterwards dissolved in the medium amounted to about 10 μgm. per flask. The same figure was arrived at by assaying the activity of petroleum-ether washings from samples of dry flasks, similarly plugged and sterilized. This amount was quite enough to give considerable growth of *Q*, which responds visibly to a concentration of 0·5 μgm. oleic acid per ml., and also to cause marked inhibition of organisms, such as *H. pertussis*, which are highly sensitive to unsaturated fatty acids. A strain of *H. pertussis* was found to grow heavily in broth with 0·01 per cent albumen in flasks with extracted cotton wool plugs, but failed completely to grow in the same medium in flasks with ordinary plugs.

Long-chain unsaturated fatty acids such as oleic, linoleic or linolenic (which may be derived from cotton wool in its natural state or after washing with soap solutions) have remarkable activity both as growth-promoters[3–7] and growth-inhibitors[2,3,8,9] of a wide variety of micro-organisms, down to a concentration of 1 μgm./ml. or less. These substances may thus be responsible for erratic results in growth experiments on sensitive micro-organisms where cotton wool is used for plugging tubes afterwards sterilized in an oven at high temperatures. To avoid this difficulty, Wright[1] suggested using a particular grade of absorbent cotton wool, and sterilizing by autoclave followed by drying at 120°. The fatty acid content of absorbent cotton wool, however, depends largely upon its method of preparation and may be higher than that of the non-absorbent variety. It is clearly preferable to attempt to get rid of the easily liberated fat by extraction with an organic solvent such as methanol (as described) or, even better, to use some substitute such as glass, 'Cellophane' or aluminium caps as recommended by Drea[2]. A more promising substitute which is being tested here at the moment is a very fine glass wool (Fibreglass, Ltd.). This is unfortunately treated with a mixture containing oleic acid in the process of manufacture, but can easily be subjected to fat-extraction and/or treated with concentrated acid and so obtained as chemically clean as the flasks themselves.

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Regulation of Oviposition in Social Hymenoptera

THE rate of increase of population in societies of social insects obviously depends upon the numbers of adults which can be produced per head of the adult population. Ideally, the numbers of eggs laid should be just appropriate to this situation, so that the prevailing food supply may be efficiently transformed.

In a study of *Bombus agrorum* Fab. kept in observation nests with free access to the open, and not fed in any way, it has been noticed that eggs excepting the first were only laid on pupal cells, and by far the majority on cells up to three days after formation.

NUMBERS OF EGGS LAID ON PUPAL CELLS 1, 2, 3, . . ., ETC., DATE AFTER FORMATION IN A COLONY OF *B. agrorum* ssp. *septentionalis* VOGT.

Age of pupal cell (days)	1	2	3	4	5	6	7	8	9	10	11	12
Numbers of eggs laid	18	50	38	18	15	9	7	0	0	8	0	0

This association of eggs with metamorphosis may have been the result of a reduced 'demand' on the part of larvæ for attention—more particularly, food; but that a direct response to the presence of pupæ was involved is perhaps suggested by the fact that the numbers of eggs laid (X) was proportional to the size of the pupal mass, that is, to the numbers of pupæ in each batch (Y). The equation relating these was

$$X = 2{\cdot}84\,Y + 0{\cdot}16$$

(standard error of regression coefficient, 0·53 eggs per pupa), which means that about three eggs were laid per pupa. By thus replacing each fully grown and metamorphosed larva with three eggs, a reasonably continuous regulation of larval numbers was achieved, as the eggs took only six days to hatch. Since several groups of brood ran concurrently, but out of phase, all ontogenetic classes were present in the nest at any time, and it seems likely that in the bumble-bee a fairly sensitive method of regulating the time of appearance and quantity of brood to the capacity of workers to tend it has been evolved.

In colonies of the ants *Myrmica lævinodis* Nyl. and *M. ruginodis* Nyl. kept in observation nests under normal climatic conditions, as well as at constant temperatures, and subjected to weekly censuses, a marked temporal association of eggs and pupæ has also been observed (see graph); and it has been noticed that oviposition tended to increase soon after metamorphosis had started. The result, in spite of the fact that the over-wintering larvæ—all in third instar—ranged in weight from 0·24 mgm. to 3·10 mgm., was not an immediate replacement, and a consequent approximately constant larval population, since the eggs took more than a month to hatch. In fact, over-wintering larvæ had usually all metamorphosed before many new larvæ appeared. Moreover, since the period of oviposition was approximately equal to the period of metamorphosis, the appearance of young larvæ coincided with the amplification of the worker force. Thus, instead of a continuous replacement of larvæ and a steady flow of material through the ontogenetic classes, there was in these species of ant, in contrast to the bumble-bee, a phasic alternation of egg and pupal increase with larval and worker increase. Two such maxima, the first larger than the second, have occurred each year in *M. lævinodis*. But although a regulation of the time of oviposition has been observed, there has been no indication so far of a quantitative relation between the numbers of pupæ formed and the number of eggs laid as in *Bombus*.

A clear understanding of the factors involved in this situation cannot be obtained until much more is known about the mode of organisation of activities in these colonies, of the times and energies necessary for performing the various actions, and of the complex effect of variations in ontogenetic class composition which a never static worker force has to cope with. If larvæ receive prime attention, then it is plausible to suggest that egg-laying is proportional to the spare worker-power up to a point where the queen's constitution becomes the limiting factor. But it is equally plausible to suggest that in ants, as in bumble-bees, the queen responds directly to the arrival of pupæ, an action which is facilitated by the increasing attention the workers can give her. It is not inconceivable that some hormone affecting both processes—egg formation and metamorphosis—may be transmitted or absorbed through the medium of the 'social stomach'.

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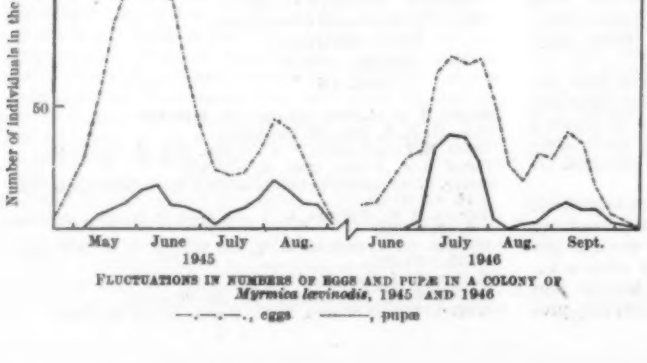

FLUCTUATIONS IN NUMBERS OF EGGS AND PUPÆ IN A COLONY OF *Myrmica lævinodis*, 1945 AND 1946

—.—.—., eggs ———, pupæ

Ciliate Protozoan Fauna of Soil and Inland Waters

A YEAR'S study of the bacteria in the current core of a chalk stream has shown that there is a natural water bacterial flora (*Pseudomonas* sp., *Flavobacteria*, *Micrococci* sp.), which was supplanted by a bacterial flora of soil types (*Bs. mycoides*, *Bs. subtilis*, *Actinomyces* sp., *Bt. coli* irregulars) after heavy rain, floods or prolonged periods of hot dry weather when presumably a continuous rain of earth crumbled into the stream.

It was also observed that bacteria-eating ciliates in the current core were most numerous and most varied when a soil bacterial flora predominated. Further, many of these bacteria-eating ciliates (for example, *Colpoda*, *Halteria*, *Holophyra*) appeared in numbers after heavy rain, floods or periods of hot dry weather, that is, after the same physical conditions which had ushered a soil bacterial flora into the stream.

It was assumed that soil ciliate protozoa might have been washed into the stream, and examination of the soil on its banks, and of the soil 200 yards

away on the banks of gullies emptying into the stream, showed the presence of ciliates many of which were indistinguishable from forms found in the stream (*Colpoda*, *Holophyra*, *Oxytricha*, *Halteria*). Ciliate protozoa indistinguishable from forms found in the stream were also obtained from within dried mud originally excavated from the bottom of the stream and cast on adjoining fields (*Oxytricha*, *Halteria*).

Singh[1] observes that "the satisfactory edible bacteria in estimating protozoal numbers [in the soil] belong to strains of small cocci or non-sporing rods". Following this suggestion, it was found that soil ciliate protozoa from the above situations developed only slowly in artificial culture—in one to two weeks—if the sole food supply was the natural soil bacteria. If, however, the culture was inoculated with micrococci isolated from the stream, a massive development occurred within three to five days.

From these observations it is suggested that there is a free exchange between soil ciliate protozoa and those of inland waters, and that any distinction drawn between them is apparent and not real; in short, that water ciliates are identical with those of the soil, one habitat being the source of the other.

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Separation of Polar from Non-Polar Molecules

AFTER an interruption due to the War, I have re-commenced experiments aiming at the separation of molecules having a permanent dipole moment from non-polar molecules in liquid mixtures by the aid of a non-uniform electric field.

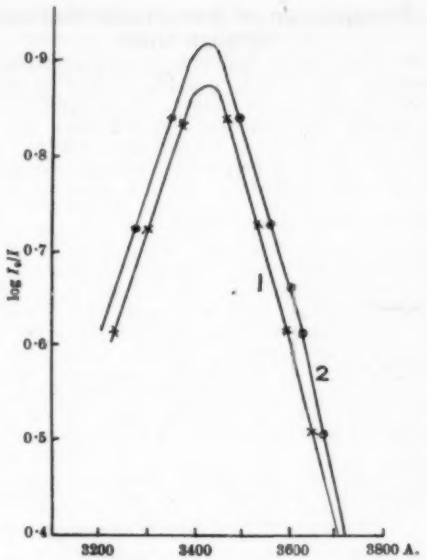
The ratio of the polar and non-polar molecules (N_p/N_n) will undergo a change to the value $(N_p/N_n)_r$ at a point r with the electric field strength E_r given by the expression:

$$\left(\frac{N_p}{N_n}\right)_r = \left(\frac{N_p}{N_n}\right)_0 \exp \frac{\mu E_r \cos\theta + \frac{1}{2} E_r^2 (\alpha_p - \alpha_n)}{kT},$$

where μ is the permanent dipole moment, E_r the intensity of the electric field at the point concerned, $\cos\theta$ the mean cosine of the orientation angle, α_p and α_n the polarizabilities of the polar and non-polar molecules respectively, and k the Boltzmann constant.

In evaluating this formula, which does not take into account a possible interaction between polar and non-polar molecules, the complete Langevin function for the calculation of the values of $\cos\theta$ has been used. Plotting the ratio $(N_p/N_n)_r$ against the logarithm of the field intensity and making $(N_p/N_n)_0 = 1$ shows that up to 10^5 volt./cm. no appreciable deviation from the value 1 is to be expected. But from that value on a very rapid increase occurs, reaching several per cent at 10^6 volt./cm. At still higher fields, which of course cannot be reached due to the sparking potential, the ratio would increase rapidly to very great values.

In the apparatus used the liquid mixture is placed in a radial field produced in a metallic cylinder of 2 cm. diameter coaxial with a thin tungsten wire of 0·020 mm. diameter, which passes through a glass capillary of 0·1 mm. diameter. The tungsten wire protrudes 1–2 mm. beyond the end of the capillary. On applying potentials up to 10,000 volts, which are below the sparking potential of the cell, an electric field of the magnitude of 10^6 volts./cm. is established close to the thin wire. The liquid around it up to a distance of 0·1 mm. is continuously collected at a very slow rate and its refractive index is compared with that of the original solution by means of a liquid-interferometer.



Using benzene–nitrobenzene mixtures, and plotting the observed interferometric deviation against the potential applied, it is found that an enrichment of nitrobenzene up to 0·7 per cent takes place in the solution for 6,000 volts applied. With *p*-nitroaniline solution in benzene and potentials up to 10,000 volts, a change of the concentration up to 12 per cent has been observed. The accompanying graph shows the ultra-violet absorption of the *p*-nitroaniline solution collected from the vicinity of the tungsten wire (Curve 2) and the absorption curve of the original solution (Curve 1). The position of the maximum is not altered, but the extinction is increased, showing an enrichment of the solution for the polar molecules of *p*-nitroaniline.

In a second apparatus the mixture was allowed to pass through a metallic net, with the horizontal wires forming the negative pole and the vertical ones the positive. They were insulated from each other so that potentials of up to 1,000 volts could be safely used. The net was wound about a glass rod and then placed in a glass tube. The dimensions were such that there were 42,000 intersection points, forming the non-uniform field, in a volume of 100 ml. After passing through the net, the liquid proves to be poorer in polar molecules compared with the liquid remaining in the tube. This shows that the net acted as a dipole filter.

At present work is in progress to amplify the changes in concentration by application of the method of counter-streams. A fuller report of this work is being prepared.

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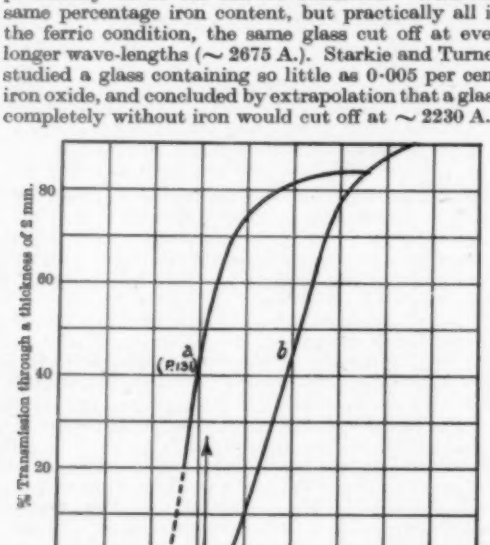
Transmission of Bactericidal Radiation through Glass

It is well known that iron, present in glasses as an impurity, has a most important effect in reducing their transmission of ultra-violet radiation. Of both theoretical and practical importance is the exact quantitative effect, at various wave-lengths, of iron in both the ferrous and ferric condition and in glasses of various compositions. On this question the most authoritative work known to me is that of D. Starkie and W. E. S. Turner[1] who, unlike other authors, quoted precise chemical compositions, including ferrous and ferric iron contents, together with complete transmission data. Curve *P*.131 in the graph is taken from their work and shows that a soft soda glass containing 0·01 per cent of iron oxide cut off completely at ~ 2650 A., the iron in the glass being practically all in the ferrous condition. With the same percentage iron content, but practically all in the ferric condition, the same glass cut off at even longer wave-lengths (~ 2675 A.). Starkie and Turner studied a glass containing so little as 0·005 per cent iron oxide, and concluded by extrapolation that a glass completely without iron would cut off at ~ 2230 A.



PERCENTAGE TRANSMISSION CURVES FOR (*a*) *P*.131 GLASS CONTAINING 0·010 PER CENT IRON OXIDE; (*b*) ONE OF THE NEW GLASSES CONTAINING 0·010 PER CENT IRON OXIDE, THE CURVE IN THE LATTER CASE *not* BEING CORRECTED FOR REFLEXION LOSSES. THE VERTICAL ARROW INDICATES THE 2537 A. LINE

Small melts made in this Laboratory during 1939, using platinum–rhodium crucibles and pure materials, showed that it was possible to make a silicate glass containing about 15 per cent of alkali oxides and having a transmission at 2537 A. of ~ 70 per cent for a thickness of 1 mm. This work was interrupted by the War; but the subject is now under investigation again.

In large-scale melting it is very difficult to keep the iron oxide very much below 0·01 per cent, and an important question, therefore, is the possibility of obtaining good transmission at 2537 A. with about this percentage of iron oxide. We have established that a soft soda glass of linear expansion coefficient ~ $9{\cdot}5 \times 10^{-6}$ per °C., and containing 0·01 per cent of iron oxide, may have the transmission curve shown in the graph, when made on a scale of several hundredweights at a time.

Two main conclusions may be drawn from the work, as follows:

(*a*) Soft glasses, even when containing as much as 0·01 per cent iron oxide, may be made with remarkably good ultra-violet transmission at 2537 A., and much remains to be done before one can say precisely where the absorption edges occur for glasses completely free from iron. It may be remarked in this connexion that even the new glass referred to is distinctly coloured when viewed in thicknesses of a few inches. It follows that one cannot yet estimate exactly the specific effect the main constituent oxides of glasses have on the position of the absorption bands, and this should be remembered when studying the work of previous experimenters.

(*b*) Hitherto, in the manufacture of bactericidal lamps, it has been assumed that hard borosilicate glasses must be used. The above work shows that glasses of expansion coefficient ~ $9{\cdot}5 \times 10^{-6}$ may have good transmission at 2537 A., and this has the practical advantage that seals may be made to relatively easily available alloys and soft glasses.

The whole subject is under active investigation in this Laboratory, and it is hoped to publish detailed results at a later date. I would thank Mr. L. J. Davies, director of research, for permission to publish this communication.

J. E. Stanworth

Research Laboratory,
British Thomson-Houston Co., Ltd.,
Rugby.

[1] Starkie, D., and Turner, W. E. S., *J. Soc. Glass Tech.*, **15**, 365 (1931).

Stimulation of Growth in Pigs by Iodinated Casein and Stilbœstrol

The earlier attempts to stimulate the growth-rate of pigs by administration of thyroid-active substances[1] and of synthetic œstrogens[2] have been followed by tests in which both treatments were given simultaneously.

	Average initial weight	Average final weight after 19 weeks	Average gain	Average amount of food required for 1 lb. live-weight gain
Trial 1				
Control animals (6)	41·0	201·5	160·5	3·79
Treated animals (6)	41·8	219·3	177·5	3·63
Trial 2				
Control animals (6)	43·5	218·8	175·3	3·76
Treated animals (6)	42·7	235·0	192·3	3·44
Both trials combined				
Control animals (12)	42·3	210·2	167·9	3·78
Treated animals (12)	42·3	227·2	184·9	3·54

Young growing castrated male pigs, ten to twelve weeks old at the beginning of the trials, received daily additions of iodinated casein and stilbœstrol to the food throughout the fattening period. The results for the first twelve pairs are now available. The treated pigs showed a substantially greater rate of growth than their control litter-mates, and more efficient food utilization. No untoward effects due to treatment have been observed. The accompanying table gives the relevant information. Further tests are in progress to confirm these preliminary findings and will be reported later.

The help of Miss E. Henriques is gratefully acknowledged.

R. Braude

National Institute for Research in Dairying,
University of Reading. Feb. 12.

[1] Braude, R., *J. Agric. Sci.*, **37**, 46 (1947).
[2] Braude, R., *Brit. J. Nutrit.*, **1**, iii (1947).

A Radioactive Local Anæsthetic

THE method of production of the local anæsthetic, dibromo procaine, described below, is of wide application, permitting the rapid formation of a saturated solution of radioactive hydrobromic acid from a small mass of active bromide. The hydrobromic acid serves as a basis for many brominations.

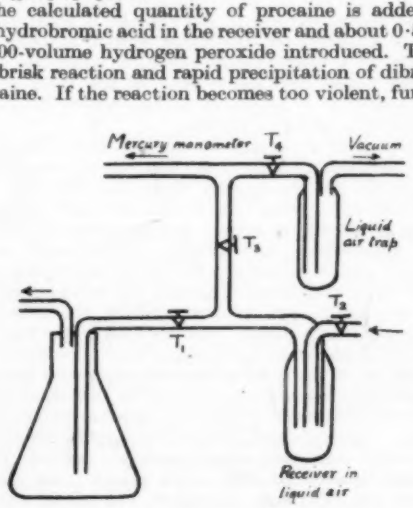
A solution of active bromide is converted to silver bromide by addition of excess silver nitrate. The precipitated silver bromide is dried, and reduced in a silica tube furnace at 800° C. by a stream of dry hydrogen. The furnace outflow, consisting of hydrogen and hydrobromic acid gas, is led through a receiver standing in liquid air and containing the calculated volume of distilled water. A manometer at the hydrogen inlet gives warning by showing a rise of pressure should the receiver become 'iced up'; this should not occur if the bore of the receiver tube is adequate for the mass of silver bromide to be reduced.

The hydrogen escaping from the receiver is led through a solution of silver nitrate (left of diagram), thence out to the air. Clouding of this solution indicates that hydrobromic acid is being carried through, and the rate of hydrogen flow is appropriately adjusted. Forty-five minutes is more than adequate for total reduction of 0·5 gm. silver bromide.

The furnace is disconnected, taps T_1 and T_2 closed, T_3 and T_4 opened and the receiver exhausted with a suitable pump. Tap T_4 is now closed and the receiver, connected only with the manometer in the vacuum circuit, is removed from the liquid air and its base slowly immersed in water at room temperature; the ice melts before the hydrobromic acid higher in the trap. The acid then resumes the gaseous state and dissolves in the water. Should the manometer show a significant rise of pressure above atmospheric, it is only necessary to re-immerse the flask in liquid air for a moment and recommence. In about five minutes, the fuming radioactive hydrobromic acid is ready for use.

Bromination is achieved according to the method of Morel and Leulier[1], who, in 1929, produced a dibromo procaine and investigated it pharmacologically and chemically, ascribing to it the formula $C_{13}H_{18}Br_2N_2O_2HBr$.

The calculated quantity of procaine is added to the hydrobromic acid in the receiver and about 0·5 c.c. of 100-volume hydrogen peroxide introduced. There is a brisk reaction and rapid precipitation of dibromo procaine. If the reaction becomes too violent, further peroxide is added to slow it down. The time taken for this reaction may vary from minutes to hours, depending on the concentration of reagents and, since the half-life of Br^{82} is only 34 hours, the need for a concentrated acid is obvious. In my series of experiments, the dibromo procaine was recrystallized. The conversion of potassium bromide to dibromo procaine can be completed comfortably in one and a half hours. An account of my radio-autographic studies will be given later.



Discussion. The method described has advantages over the simpler techniques for bromide – acid conversion. It is almost quantitative and commends itself when a bromide of small mass and low activity is to be dealt with. It involves no intermediate stages with loss of active substance. Radioactive bromine is usually provided as a simple bromide, so the method has a wide field of application; it is also satisfactory with highly active bromide, in that the system is a closed one and in no stage is a radioactive gas, with its attendant hazards, liberated in the laboratory.

Morel *et al.* have produced several brominated natural alkaloids, and have studied their properties, thus paving the way for experiments with the active bromine isotope.

As yet the synthesis of a complex molecule incorporating one or more radioactive C^{14} atoms presents considerable difficulty and involves losses of C^{14}, in spite of the most careful technique, while many compounds of great pharmacological interest cannot yet be synthesized; it is to bridge this gap that some simple method of labelling is required, and a halogen seems to be the 'label' of greatest general utility at present.

I wish to thank the staff of the Liverpool and Cambridge cyclotrons, and also Prof. A. D. Macdonald, for facilities in his laboratory.

FRANK HOWARTH

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Victoria University of Manchester.

Feb. 13.

[1] Morel, A., Leulier, A., and Denoyel, P., *Bull. Soc. Chim.*, **45**, 435, 457 (1929).

"Plant Geography"

BOOK reviews are of value not only to readers but also to writers, and I am therefore sorry that Sir Edward Salisbury did not, in his notice of my book "The Geography of the Flowering Plants" in *Nature* of May 8, give us his views on any of the more profound modern problems of phytogeography with which it tries to deal.

With regard to the point which he particularly stresses, namely, the question of the value of specialized dispersal mechanisms, I remain unrepentant and see no reason to modify my belief that a broad acquaintance with the Angiosperms and their distribution allows of no other conclusion than that which the reviewer criticizes.

It is also only proper to point out that the incomplete sentence which Sir Edward quotes from my book in the second paragraph of his notice is not, as the context might imply, from the chapter on the dispersal of plants but from an earlier chapter, and from the very pages of it in which the "critical consideration" he desires is, in fact, given at some length.

RONALD GOOD

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FRACTIONAL DISTILLATION AND ITS APPLICATION IN THE CONCENTRATION OF THE HEAVY ISOTOPES OF OXYGEN AND HYDROGEN

By Dr. I. DOSTROVSKY, Prof. E. D. HUGHES
AND
Dr. D. R. LLEWELLYN
University College of North Wales, Bangor

IN a previous communication[1] we described a convenient type of fractionating column suitable for the concentration of the heavy isotopes of oxygen and hydrogen in water. The glass assembly was efficient for comparatively slow distillations and was capable of producing valuable enrichments of O^{18} in sufficient quantities of water to be useful for tracer studies. A column 12 ft. in length and $\frac{3}{4}$ in. in diameter had efficiency equivalent to about 450 theoretical plates for a boil-up rate of 500 ml. per hour, and, to give an illustration of its performance, in twenty-four days of continuous distillation at atmospheric pressure it produced 500 ml. of water with nearly a three-fold enrichment of O^{18}. As expected, the production of the desired isotopes is increased by operating the column under reduced pressure. Thus, a five-fold enrichment of O^{18} is obtained after six weeks of continuous distillation at 150 mm. pressure. A further increase results by periodically replacing the reservoir water (which becomes lighter during the course of an experiment) by fresh water. It is more convenient, however, to use the same stock throughout a run, and this has generally been our practice with this column.

The successful use of the apparatus prompted us to attempt the construction of a larger column, our aim being to maintain approximately the platage of our first design while increasing the throughput by about ten-fold. Our general intention was to demonstrate the possibilities of such columns in isotopic work and other investigations involving the close fractionation of mixtures. The unsuitability of the radioactive isotopes of oxygen for tracer studies, and the lack of success hitherto experienced in devising other convenient methods for the separation of the stable isotopes of this element in substantial quantities, gave added interest to the application in this instance of the distillation method, which, on the basis of the results of previous investigators[2] and our experience with the smaller column, promised to be especially useful in the case of oxygen. Our immediate target then was to obtain good enrichments of O^{18}, and, in particular, to obtain a rapid supply of sufficient quantities of enriched material for a second-stage concentration in the glass column previously described. An ultimate objective, using various columns in conjunction, is to obtain isotopically pure O_2^{18} and H_2O^{18} for studies of their properties, and to have ample quantities of highly enriched samples suitable for all types of tracer experiments. Accordingly, we have constructed a 30-ft. metal column of 3 in. diameter, suitable for continuous fractionation, and we now wish to place on record its chief characteristics.

The still is designed to operate at reduced pressures with either ordinary distilled water or enriched water as feed stock. The main section consists of a 31-ft. length of 3-in., 16-gauge copper pipe, and contains a 30-ft. portion filled with 100-mesh phosphor-bronze packing, as in the column previously described[1]. The remaining length accommodates the inlet from a feed pipe, the outlet to an overflow pipe and a short reflux condenser, the last two items being used only in connexion with the flooding process. The top of the column is connected to a pipe leading to the main condensers, from which another pipe carries the condensate to a reservoir situated on the level of the base of the column. In the first mode of operation, the condensate displaces from the reservoir (containing enriched material in this case) an equal volume of water, which is conveyed through the feed pipe to the top of the column. In the second method, the displaced water is run into distilled water containers (and may be used for ordinary laboratory purposes), while fresh distilled water is fed to the top of the column through a flowmeter[3] which records and automatically controls the rate of flow. With this column, which is especially useful for the first stage of concentration, we generally employ the latter method.

The water flowing down the column is led through a glass tube to the bottom of the boiler, which consists of a 'Pyrex' tube, 18 in. in length and $2\frac{3}{4}$ in. in diameter, containing four one-kilowatt tubular heaters. The boiler has a working volume of 200 ml. of water, and a level-controlling device is incorporated which keeps this volume sensibly constant. The vapour is returned to the bottom of the column through a copper tube (diameter 1 in.). A connexion is taken from this tube to a manometer and to one side of a differential manometer, the other side of which is connected to the top of the condenser, to a manostat and to the vacuum line. Samples of water can be removed from the boiler through a side tube and valve.

Thermal insulation of the column is provided by 'Fibreglass' pipe lagging ($2\frac{1}{2}$ in. thick) built in two layers with a compensating electric heater wound on the inner layer. The input of this electric heater is controlled by a 'Simmerstat' and adjusted to compensate for the residual heat loss. A number of thermocouples and differential thermocouples are incorporated throughout the length of the jacket as an aid to the correct adjustment of the jacket heater.

The centre section of the column is fixed to the wall of a laboratory, the upper portion extending to the top of a ventilator on the roof, while the lower section passes through a hole in the floor of the laboratory to a basement below, where it is supported by a brick structure.

Since it is necessary to operate the column for long periods without attention, it is essential to safeguard the equipment from damage and the enriched water from loss consequent upon failure of water or electricity supply or breakdown in parts of the apparatus; accordingly, appropriate safety devices and automatic controls are incorporated.

The following details indicate the achievements of the column in preliminary runs on the first-stage fractionation of water. The distilled water feed-rate was 3,850 ml./hr. and the pressures in the boiler and at the top of the column were 460 mm. and 290 mm. of mercury respectively. We give two illustrations of the performance of the still in production experiments. After sixteen days of continuous distillation the boiler contained approximately 1 per cent H_2O^{18} (excess density (H_2O^{18}) = 755 p.p.m.; enrichment nearly five-fold) and, thereafter, 115 ml. of water of

this quality could be withdrawn daily for further concentration. (Using the column previously described[1], a second-stage fractionation of water obtained in this manner is expected to yield 5 per cent H_2O^{18}.) The operating conditions, which were intended to be suitable for O^{18} enrichment, were not particularly appropriate for the production of deuterium, but it is of interest to record that after the same period (16 days) the boiler water in the first stage of distillation contained 3 per cent of HDO. The daily withdrawal of 115 ml. of water afterwards reduced this figure to a steady value of 1·1 per cent (excess density (HDO^{16}) = 560 p.p.m.; enrichment factor = c. 32). After thirty-two days of continuous distillation, a six-fold enrichment of O^{18} was obtained in the boiler water, while the deuterium concentration was about 180 times the normal value. At this point, 30 ml. of water of approximately the same quality in O^{18} (excess density (H_2O^{18}) = 1,073 p.p.m.) could be withdrawn daily from the still, but this rate of removal lowered the deuterium enrichment to about 140 times the normal value (excess density (HDO^{16}) = 2,530 p.p.m.; HDO = 5 per cent). If applied appropriately in conjunction with the electrolytic process, the use of the distillation method, employing suitable modifications and enlargements of the type of still described, may be of value in the production of pure deuterium oxide. This and similar applications are being further explored.

When no water is withdrawn from the boiler the enrichment (q') of O^{18} is represented approximately (except for small t values) by the equation

$$q' = 6{\cdot}80 - 5{\cdot}45\exp(-t/16) - 0{\cdot}18\exp(-t/0{\cdot}77) - \ldots,$$

q' being the ratio of the concentrations of O^{18} in the boiler water and in the feed-stock and t the time in days from the commencement of the run. Except for small values of t, the first two terms of the expression provide a useful approximation formula for q'. The enrichment of deuterium (q'') over the range examined approximately follows the linear relationship $q'' - 1 = 5{\cdot}64\ t$, q'' representing the ratio of concentrations of deuterium in the boiler water and in the feed-stock and t being measured in days as before. Assuming a value of α, the ratio of the vapour pressures of H_2O^{16} and H_2O^{18}, deduced from the data of Wahl and Urey[4], namely, 1·0044, the efficiency of the column under the conditions described is equivalent to about 435 theoretical plates. An analysis of our results, however, indicates a considerably higher value of α than that deduced from the data of previous workers[5]. Discussion of this point is postponed pending the results of further investigations.

A detailed description of the construction and characteristics of the column will be published elsewhere.

We wish to thank Imperial Chemical Industries, Ltd., Billingham Division, for advance information concerning the operation of their metal-gauze-packed fractionation columns[6].

[1] Dostrovsky and Hughes, *Nature*, **158**, 164 (1946).
[2] Urey, Pegram and Huffman, *J. Chem. Phys.*, **4**, 623 (1936). Huffman and Urey, *Ind. Eng. Chem.*, **29**, 531 (1937). Datta, Day and Ingold, *J. Chem. Soc.*, 1968 (1937). Brodski, Alexandrovitsch and Skarre, *Acta Physicochem. U.R.S.S.*, **7**, 469 (1937); *J. Phys. Chem. Russ.*, **10**, 538 (1937) and subsequent papers. Winter, Carlton and Briscoe, *J. Chem. Soc.*, 131 (1940). Thode, Smith and Walkling, *Canadian J. Res.*, **22**, 127 (1944).
[3] Dostrovsky and Llewellyn, *J. Sci. Instr.*, **25**, 137 (1948).
[4] Wahl and Urey, *J. Chem. Phys.*, **3**, 411 (1935).
[5] Cf. Riesenfeld and Chang, *Z. phys. Chem.*, **33**, B, 127 (1936).
[6] Cf. B.P. 578,309.

REVERSAL OF VERNALIZATION BY HIGH TEMPERATURE

By Prof. F. G. GREGORY, F.R.S.,
AND
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In a previous letter[1], evidence was presented showing that 'Petkus' winter rye vernalized for six weeks and then exposed for a short period (1–4 days) to a temperature of 35° C. showed a retardation of flowering, thus indicating a partial reversal of the vernalized condition. The complete devernalization reported by Efeikin[2] and Tetjurev[3] using winter wheat was not obtained in this experiment with winter rye. After a period of vernalization of twelve weeks, however, high temperature completely failed to cause retardation in flowering. The conclusion was therefore drawn that as the period of low temperature treatment is extended the vernalized condition induced becomes less and less easily reversible and finally is completely stable. This suggestion has been completely substantiated by an experiment carried out in 1947. Winter rye was vernalized for varying periods, using the 'restricted moisture' method, and at the end of treatment was exposed for three days to a temperature of 35° C. The grain was then sown, both in the field and in pots, and the flowering behaviour assessed by the 'scoring method' of Gregory and Purvis[4], which gives a quantitative measure of 'earliness' of flowering. The results for plants grown in the field are presented in Table 1.

Table 1. Retardation of winter rye vernalized for different periods and then heated to 35° C. for 3 days. Field culture. Number of replicates in brackets

Duration of vernalization	'Scores' Unheated	'Scores' Heated	Difference	Degree of vernalization	% reduction by heat
0 (Control)	24±1·4 (42)	24±0·9 (43)	—	—	—
2 weeks	28±2·6 (40)	24±1·3 (34)	3·2±3·1	4	100
3	62±4·4 (59)	41±3·9 (45)	22·2±6·1	38	58
4	79±4·6 (56)	48±5·3 (44)	30·5±7·0	55	55
5	108±1·1 (42)	87±5·5 (38)	21·2±5·4	84	25
6	112±0·8 (48)	98±3·0 (49)	13·8±3·1	88	16
8 (5 days heat)	121±0·5 (53)	118±1·0 (45)	3·0±1·1	97	3

High temperature following on all periods of vernalization, except the shortest (two weeks), led to a retardation in flowering which was statistically significant; two weeks of vernalization failed to give a significant acceleration of flowering and therefore no subsequent reversal by heat could be expected. The figures entered in column 2 of the table show the usual effect of increasing duration of vernalization upon the acceleration of flowering; those in column 3 the 'scores' for plants grown from the grain heated after vernalization; by difference the effect of the subsequent heat treatment on the 'score' is obtained and entered in column 4. The degree of vernalization of the unheated grains is shown in column 5, and the reversal of vernalization by heat is entered in column 6. The progressive reduction in the effect of the heat

Table 2. Retardation of winter rye vernalized for different periods and heated at 35° C. for 3 days. Pot culture. Number of replicates in brackets

Duration of vernalization	'Scores' Unheated	'Scores' Heated	Difference	Degree of vernalization	% reduction by heat
0 (Control)	26±3·0 (5)	34±4·0 (6)	−8·2±5·2	—	—
2 weeks	58±10·9 (7)	31±4·1 (10)	27·0±10·3	32	84
3	89±6·2 (8)	69±9·5 (9)	20·4±11·6	63	32
4	113±2·5 (11)	96±5·0 (7)	17·1±4·4	87	20
6	118±1·5 (8)	114±4·7 (10)	4·3±5·4	92	4

treatment as vernalization is prolonged is very apparent. Similar results obtained with plants grown in pot culture are given in Table 2.

Replication in this experiment was much reduced by attacks of frit fly; but the numbers surviving were adequate to establish the significant devernalization by heat and the progressive decline in effect of heat with prolongation of vernalization treatment. The higher 'scores' usually found with plants in pot culture[5] have made possible a demonstration of devernalization after two weeks low-temperature treatment.

The leaf numbers for the pot culture plants are entered in Table 3.

TABLE 3. INCREASE IN LEAF NUMBER IN PLANTS VERNALIZED FOR DIFFERENT PERIODS AND THEN HEATED TO 35° C. FOR 3 DAYS. POT CULTURE. NUMBER OF REPLICATES IN BRACKETS

Duration of vernalization	'Scores' Unheated	Heated	Difference
0 (Control)	21·8±0·34 (5)	21·2±0·56 (6)	−0·6±0·98
2 weeks	19·2±1·61 (7)	22·3±0·47 (10)	3·1±1·34
3	16·2±0·38 (8)	19·8±0·73 (9)	3·6±1·09
4	12·7±0·26 (11)	18·0±2·57 (7)	5·3±0·41
6	10·8±0·45 (8)	11·8±0·53 (10)	1·0±0·91

After two, three and four weeks vernalization, subsequent heat treatment has significantly increased the leaf number, which affords conclusive evidence that retardation in flowering results from a true reversal of vernalization rather than from a mere retardation of growth-rate of the plants. A similar increase in leaf number following devernalization by heat has been noted in wheat by Efeikin[6].

Experiments on devernalization have been carried out in four successive years and have given variable results; in 1946 the reversal was insignificant despite the fact that the response to vernalization was quite normal and similar to the values for 1947 presented above. The cause of this variation is still being investigated, and there is evidence to show that the stability of the vernalized condition increases with the degree of development taking place during the low-temperature treatment, since far more reversal occurs when the grains are prevented from growing by restricting the moisture supply during vernalization than when vernalized in moist sand with unlimited water supply. Thus two lots of vernalized grain may be alike in flowering response but differ in stability of the vernalized condition. On the other hand, it is possible that the differences noted were due to revernalization by low temperature encountered after planting out the grain; for Efeikin[6] has pointed out that, in wheat, revernalization after a partial devernalization by high temperature takes place more rapidly than the original vernalization, and a similar result with Petkus rye has been obtained by us, which thus would greatly augment the effect of such low temperatures after planting out.

It is clear that any attempt to formulate the reactions resulting in vernalization must take into account this gradual establishment of an irreversible condition of vernalization; its practical importance in relation to effects of sowing date upon time of flowering of vernalized grain has been indicated elsewhere[5].

[1] Gregory, F. G., and Purvis, O. N., *Nature*, **155**, 113 (1945).
[2] Efeikin, A. K., *C.R. (Doklady) Acad. Sci. U.R.S.S.*, **25**, 308 (1939). **30**, 661 (1941).
[3] Tetjurev, V. A., *C.R. (Doklady) Acad. Sci. U.R.S.S.*, **30**, 189 (1941).
[4] Gregory, F. G., and Purvis, O. N., *Ann. Bot.*, (N.S.), II, 237 (1938).
[5] Purvis, O. N. (1948, in the press).
[6] Efeikin, A. K., *C.R. (Doklady) Acad. Sci. U.R.S.S.*, **50**, 95 (1938).

U.S. NATIONAL ACADEMY OF SCIENCES

Election of Officers and Members

AT the annual meeting of the U.S. National Academy of Sciences held in Washington during April 26–28, the following officers, members and foreign associates were elected:

Treasurer (July 1, 1948–June 30, 1952): William J. Robbins, director of the New York Botanical Garden. (The other officers of the Academy are: *President:* Alfred N. Richards; *Vice-President:* L. P. Eisenhart; *Foreign Secretary:* Detlev W. Bronk; *Home Secretary:* Fred. E. Wright.)

Members of the Council of the Academy (for a three-year term ending June 30, 1951): Carl R. Moore, professor of zoology, University of Chicago; and J. Robert Oppenheimer, director of the Institute for Advanced Study, Princeton, New Jersey. (Other members of the Council are: Alfred N. Richards, L. P. Eisenhart, Detlev W. Bronk, Fred. E. Wright, William J. Robbins, W. R. Miles, W. Albert Noyes, jun., I. I. Rabi, and Donald D. Van Slyke.)

Members: Eric G. Ball, professor of biological chemistry, Harvard Medical School; Lloyd V. Berkner, chairman of the Section of Exploratory Geophysics of the Atmosphere, Carnegie Institution of Washington; Felix Bloch, professor of physics, Stanford University; Gerty T. Cori, fellow and research associate in pharmacology and biochemistry, Washington University School of Medicine; Hallowell Davis, director of research, Central Institute for the Deaf, research professor of otolaryngology, Washington University; John R. Dunning, professor of physics, Columbia University; W. Maurice Ewing, head of the Department of Geophysics, Columbia University; Karl Folkers, assistant director of research, Merck and Co., Rahway, New Jersey; Thomas Francis, jun., professor of epidemiology and chairman of the department, School of Public Health, University of Michigan; Edwin R. Gilliland, professor of chemical engineering, Massachusetts Institute of Technology; Haldan K. Hartline, associate professor of biophysics, Hospital of the University of Pennsylvania; Ernest R. Hilgard, chairman of the Department of Psychology, Stanford University; Frank L. Horsfall, jun., member, Rockefeller Institute for Medical Research, New York; John R. Johnson, professor of chemistry, Cornell University, New York; Raymond A. Kelser, dean of the School of Veterinary Medicine and professor of bacteriology, University of Pennsylvania; Cyril N. H. Long, chairman of the Department of Physiological Chemistry, Yale University School of Medicine; Edward J. McShane, professor of mathematics, University of Virginia; Donald H. Menzel, chairman of the Department of Astronomy, Harvard University, and associate director for solar research, Harvard College Observatory; C. W. Metz, chairman of the Department of Zoology, University of Pennsylvania; Curt P. Richter, associate professor of psychobiology, Johns Hopkins University; Hermann I. Schlesinger, professor of chemistry, University of Chicago; Francis O. Schmitt, head of the Department of Biology and Biological Engineering, Massachusetts Institute of Technology; Glenn T. Seaborg, professor of chemistry, University of California, Berkeley; Gilbert M. Smith, professor of botany, Stanford University; Curt Stern, professor of zoology, Univer-

sity of California, Berkeley; Chester Stock, professor of palæontology, California Institute of Technology; James B. Sumner, professor of biochemistry, Cornell University; Edward Teller, professor of physics, University of Chicago; Kenneth V. Thimann, associate professor of botany, Harvard University; Charles A. Thomas, executive vice-president, Monsanto Chemical Co., Dayton, Ohio.

Foreign Associates: Ronald Aylmer Fisher, Arthur Balfour professor of genetics in the University of Cambridge; Prince Louis de Broglie, professor of theoretical physics, University of Paris (Sorbonne).

Medal Awards

Henry Draper Medal. The Henry Draper Medal for 1947 was conferred on Hans Albrecht Bethe, professor of physics at Cornell University, in recognition of his contributions to astronomical physics, more especially his researches on the generation of energy in the sun and stars. Since the first development of the concept of energy, one of the outstanding problems of the physical sciences has been that of the source of the tremendous flow of energy from the sun and stars. Dr. Bethe gave a brilliant, quantitative solution to this problem in terms of the nuclear transformation of hydrogen into helium, with carbon and nitrogen serving as catalysts. Dr. Bethe has furthermore used this solution to extend our knowledge of stellar interiors.

The Henry Draper Fund was established in 1883 for the purpose of striking a gold medal to be "awarded and presented from time to time by the said National Academy of Sciences to any person in the United States of America or elsewhere who shall make an original investigation in astronomical physics of sufficient importance and benefit to science to merit such recognition".

Agassiz Medal. The Agassiz Gold Medal and Honorarium for 1947 were conferred on Felix Andries Vening Meinesz, professor of geodesy and geophysics in the University of Utrecht, and president of the Netherlands Geodetic Commission, for his contributions to oceanography (see *Nature*, **160**, 169; 1947).

The Sir John Murray Fund was established in 1911 "for the purpose of founding an Alexander Agassiz gold medal, to be awarded for original contribution in the science of oceanography to scientific men in any part of the world, whenever and as often as the President and the Council may deem desirable".

Walcott Medal. The Charles Doolittle Walcott Bronze Medal and Award for 1947 were conferred on Dr. Alexander G. Vologdin, of the Palæontological Institute in Moscow. Dr. Vologdin was chosen because of his studies of Pre-Cambrian and Cambrian algæ, and particularly because of his researches on that most distinctive and enigmatic group of Cambrian organisms, the Archæocyatha. When Dr. Vologdin began his studies these early organisms were supposed to be rare and unimportant in the U.S.S.R., but he soon saw in collections brought back from central Siberia and from the southern Urals a rich field for investigation. His early results stimulated interest, and new discoveries of Cambrian formations were made in rapid succession from the Urals to the Altai and from Mongolia to Arctic Siberia. Dr. Vologdin personally made large collections of algæ and Archæocyatha from certain of these deposits, but his collections grew also by the additions from other field parties. Meanwhile, his first large monograph, "The Archæocyathinæ of Siberia", in 1931 almost doubled the known fauna of these organisms for the world. So early as 1937, when the known Archæocyatha of the world totalled approximately 400 species, some 250 were due to Dr. Vologdin. As a result of his brilliant achievements the Government of the U.S.S.R. in 1943 established a special laboratory at Moscow expressly for research in the Archæocyatha and the Pre-Cambrian and early Palæozoic algæ.

The Charles Doolittle Walcott Fund was established "to encourage and reward individual achievement in advancing our knowledge of Pre-Cambrian and Cambrian life in any part of the world". The deed of gift provides that nomination be made by a board of five, one of whom shall be appointed by the Royal Society of London, one by the Institut de France, two by the president and council of the U.S. National Academy of Sciences, and the secretary of the Smithsonian Institution.

NORMAN LOCKYER OBSERVATORY OF THE UNIVERSITY COLLEGE OF THE SOUTH WEST OF ENGLAND, EXETER

THE arrangements for transferring control of the Norman Lockyer Observatory to the University College of the South West (see *Nature* of January 3, p. 15) came to fruition on May 1, when the transfer was formally completed at a joint meeting of the two institutions. Sir Richard Gregory (chairman of the Observatory Corporation) gave possession, control and management of the Observatory to the College, and this was accepted on behalf of the College by Sir William Munday, deputy president. A new stage has thus been reached in the history of a unique attempt to develop, by private enterprise, an institution for pure research with no industrial applications.

The Observatory was founded in 1912 through the energy and foresight of Sir Norman Lockyer who, with Lady Lockyer and a small band of enthusiasts, presented land, money, instruments and practical services to the new enterprise. These early benefactors included, among others, Sir Francis McClean and his brother, Capt. W. N. McClean, who has acted as honorary secretary since the foundation. They were later joined by others and formed a Corporation under the Companies (Consolidation) Act, 1908, with articles of association approved by the Board of Trade. In spite of severe setbacks occasioned by the two world wars, the Observatory has not only survived but even developed to a considerable extent with the help of occasional short-term grants and the generosity of additional donors. Among the latter may be mentioned Sir Robert Mond, who made considerable gifts of money and equipment; also Lady Lockyer, who bequeathed the whole of her residuary estate to the Observatory, finally bringing the capital funds of the Observatory to about £40,000 in addition to about 44 acres of freehold land and much valuable equipment.

The astronomical equipment includes two twin equatorial refractors, each with a visual telescope of 10 in. aperture and an objective prism telescope (apertures 12 and 9 in. respectively) for photographing stellar spectra; also an astrographic instrument with four Zeiss lenses for direct photo-

graphy, several smaller telescopes and two 12-in. siderostats. A 30-in. reflector, by Common, and a 6-in. Cooke refractor have not yet been erected. In the laboratory is a fine recording microphotometer by Casella, a 3-prism Littrow spectrograph, various measuring micrometers and much miscellaneous apparatus. There is an excellent library, containing most of the astronomical literature published since 1912, as well as a large proportion of earlier publications from the libraries of Sir Norman Lockyer and Dr. Frank McClean.

The scientific work has been carried out by a staff which, though enthusiastic, has always been very small, consisting of a director and usually either one or two assistant astronomers. At some periods no assistants were available. The first director, Sir Norman Lockyer, was succeeded by his son, the late Dr. W. J. S. Lockyer, and Mr. D. L. Edwards (the present director). These, with their small band of colleagues, have developed the Observatory until, in the words of the Astronomer Royal, "it has earned for itself an important place in British astronomy"—an importance which is recognized throughout the world in scientific circles.

A measure of the vitality of such an institution is afforded by the number of original communications from it accepted and published by scientific societies. About forty such papers were published under the directorship of Dr. Lockyer during 1920–36, and this rate of output has been maintained, as about thirty papers have been published since that period. The amount of night-work involved may be judged from the fact that more than 10,000 photographs (mostly of stellar spectra) are now available for reference and further study—a collection which is possibly unequalled in Great Britain. All this has been built up and maintained through the generosity of private persons; but in the present world conditions further development in this way is unlikely, so that the transfer to the University College will not only place the Observatory on a permanent responsible foundation but also give the best possible chance of future expansion.

The method of achieving the transfer, however, namely, by keeping the Corporation in existence but allowing a decisive majority on its Council to Exeter representatives, retains a pleasing link with the past and leaves a convenient channel available to any further flow of benefactions from private enterprise, great or small, should that arise in the future. It also retains the possibility of enlisting the interest and active assistance of leading British astronomers in the Observatory. Many of the most eminent of these have given valuable help from the beginning, by serving on the Council or Research Committee or in other ways, and the Council of the new Corporation still includes a number of well-known astronomers who are prepared to give active support in a similar way.

The University College authorities, on their side, are to be congratulated on acquiring such a well-established institution for astronomical research, with considerable endowments—a possession which is unequalled in any but the older universities. This was fully recognized by Sir William Munday, who regarded the union as an important milestone in the progress of the College and as helping it to obtain the full university charter which is desired. The responsibilities attached to the gift are also fully realized, and it is the intention of the College to do everything possible not only to maintain but also to develop the Observatory in the future. The event is thus of mutual benefit to the institutions concerned and also, it is to be expected, to astronomical research in Britain. The considerable advancements in this direction made in the past should receive additional impetus and it will always be remembered (in the words of a vote of thanks proposed by the Astronomer Royal) "that these achievements constitute a lasting memorial of gratitude to the spirit of the donors".

LONG ASHTON RESEARCH STATION

THE annual report for 1946 of the Agricultural and Horticultural Research Station, Long Ashton, Bristol, marks a year of change, when members of the advisory staff were transferred to the National Agricultural Advisory Service at Bracken Hill, Leigh Woods, close to the Station. This proximity should allow continued close liaison.

Several studies deal with nutrition of fruit and vegetable crops. An interesting result of work by E. J. Hewitt is that symptoms of acid damage are largely those of excess manganese and low calcium. T. Wallace, W. Morley Davies, D. J. D. Nicholas and E. J. Hewitt show that liming will correct this trouble; but residual deficiencies of magnesium, potash, phosphorus and nitrogen will still require treatment. Inorganic fertilizers are compared with organic manures such as sewage sludge, town refuse, and straw composted with sewage sludge, by C. Bould and E. Catlow. This is part of a long-term experiment on cultural systems for apples and black currants.

L. C. Luckwill has found that the methyl ester of alpha-naphthalene acetic acid will delay sprouting of stored potatoes. Spring treatment is effective at the rate of $\frac{1}{4}$ oz. per ton, and its use would seem economically feasible for certain purposes. An important feature about winter wash emulsions is their resistance to rain, and S. H. Bennett, H. G. H. Kearns and H. Martin find, *inter alia*, that dinitrocresol washes are more rain-proof than tar-oil emulsions.

A detailed study of hop diseases and pests in the west Midlands is being made by E. H. Wilkinson, who is investigating virus diseases and the condition known as split leaf blotch, and J. F. Southey, who surveys the insects associated with this crop. J. A. H. Tolhurst has surveyed the incidence of the virus disease nettlehead in relation to soil conditions and nutritional status of the plant. Preliminary results suggest that there may be a correlation with soil types, but none between the amounts of nitrate nitrogen, phosphate, potassium, calcium and magnesium in the host plant. Serious losses of field beans have been caused by chocolate spot disease, and L. Ogilvie and M. Munro suggest manuring with phosphate and potash, and the avoidance of close, sheltered sites, as measures against the trouble. M. Miles discusses the importance of the bean seed fly in England, and A. Stringer makes the interesting point that mature *Solanum polyadenium* plants are immune from aphid attack largely because a gummy secretion from the plant clogs the legs of the aphids.

An important aspect of the Station's work is its investigation of factors affecting quality of fresh and preserved fruit and vegetables. M. E. Kieser and A. Pollard find that from one half to two thirds of the

vitamin C in apples is retained on cooking, and the largest amounts of this vitamin occur in cider varieties. J. D. Bryan reports that the organic acid in plums and apples is almost all malic, in black currants chiefly citric, whereas gooseberries and tomato have a mixture of the two. Some potato varieties blacken on cooking, and have unsuitable texture; A. Pollard, M. E. Kieser and B. A. Crang show that cooking quality is mainly dependent on site, and the correction of manurial deficiencies improves the quality if its initial level was sufficiently high.

It seems appropriate that the report should close with a historical account, by R. W. Marsh, of the advisory agricultural services of the University of Bristol, which have been in operation since 1912; they have gradually gained the increasing confidence of farmer and grower, and should proceed to an even more useful future under the National Agricultural Service.

INTERNATIONAL ASPECTS OF THE RADIO-FREQUENCY SPECTRUM

DURING the summer of 1947, a series of International Telecommunication and Radio Conferences were held at Atlantic City, U.S.A., and the proceedings and conclusions of these have recently been published from the headquarters of the International Telecommunications Union at Berne, Switzerland. The object of these conferences was to revise the radio-communication regulations and the convention last formulated at Cairo in 1938 (see *Nature*, **141**, 195; 1938), and to re-plan the allocation of radio frequencies for the many and varied applications in use at the present time. A summary of the findings of the Atlantic City Conferences, which were attended by nearly thirty British delegates under the leadership of Sir Stanley Angwin, is given in the April issue of the *Wireless World*.

Since the drafting of the Cairo regulations, the radio-frequency spectrum has been extended very considerably at the high-frequency end, while many fresh applications have arisen for which it is necessary to find frequencies either for exclusive use or for sharing with other services in the same or other parts of the world. Under the new regulations, specific provision is made for radio navigation systems, for radio aids to meteorology and for the transmission of standard frequencies of very high accuracy. In addition, certain limited bands have been designated for industrial, scientific and medical equipment: for Great Britain, and in some cases elsewhere, the frequencies assigned for these purposes are 13·56, 27·12, 40·68, 2450 and 5850 Mc./s. Within these bands, any emission from apparatus used for industrial, scientific and medical purposes enjoys priority over other services operated within the bands. Elsewhere in the spectrum, all such apparatus must presumably be screened or operated in such a manner as to avoid any interference with other radio services.

For the purpose of frequency allocations for the many types of communication, broadcasting, radar and navigational aids, the world was divided at Atlantic City into three regions. Region 1 comprises Europe, the U.S.S.R. territory outside Europe, the Mongolian Republic and Asia Minor and Africa; Region 2 covers the whole of the western hemisphere from Greenland to Hawaii; while Region 3 comprises Australia, New Zealand, Oceania and that part of Asia not included in Region 1. It has also been found necessary to re-define and extend the zone in which certain frequencies are allocated for Tropical Zone broadcasting.

A most useful guide to the radio frequency allocations made at Atlantic City has been issued by the Radio Corporation of America in the form of a coloured chart. This chart covers the spectrum between 10 kc./s. (wave-length 30 km.) and more than 30,000 Mc./s. (wave-length 1 cm.); and it shows for each of the three regions described above the bands of frequencies proposed for twenty-three different services. It is to be noted that no specific allocations are yet proposed above 10,500 Mc./s., such higher frequencies being still regarded as for experimental purposes. While some of the allocations are already in being, it is recommended that the provisions become effective during 1949. One of the most important outcomes, however, of the Atlantic City conferences was the decision to set up an International Frequency Registration Board, which has already begun its task of examining all notifications of the proposed use of frequencies with the view of including those approved in the Master International Frequency Register. In addition to dealing with the allocation of frequencies, the new regulations contain a number of new definitions of the terms now used in radio engineering and scientific work, and also a revised classification of the various portions of the radio spectrum, and of the types of transmission and the systems of modulation now in common use.

Bearing in mind the extent and complexity of modern telecommunications technique, it must be a source of satisfaction to all those who participated in the conferences that such a large measure of agreement has been obtained on the methods of conducting world-wide radio communications.

FORTHCOMING EVENTS

Monday, May 31

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5.30 p.m.—"Photo-Canada" (Kodachrome Film with Sound Commentary).

Wednesday, June 2—Saturday, June 5

TEXTILE INSTITUTE (at Buxton).—Conference on "The Organisation of the Textile Industry and Textile Production".

Thursday, June 3

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Messrs. E. R. Andrew, M. Desirant and D. Shoenberg: "The Intermediate State of Superconductors".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 5.15 p.m.—Annual General Meeting.

CHEMICAL SOCIETY (at the Royal Institution, 21 Albemarle Street, London, W.1), at 7.30 p.m.—Prof. L. C. Pauling, For.Mem.R.S.: "The Modern Theory of Valency" (Liversidge Lecture).

Friday, June 4

PHYSICAL SOCIETY (in the Lecture Theatre, Science Museum, Exhibition Road, London, S.W.7), at 5 p.m.—Sir George Thomson, F.R.S.: "The Growth of Crystals" (32nd Guthrie Lecture).

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Dr. F. J. North: "A Cave near Aberdare, Glamorgan; Geological Notes and Queries".

INSTITUTION OF ELECTRONICS, NORTH-WESTERN BRANCH (in the Reynolds Hall, College of Technology, Manchester), at 6.30 p.m.—Mr. L. C. Jeaty: "Television".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SECRETARY AND REGISTRAR—The Secretary and Registrar, University College of North Wales, Bangor (June 5).

LECTURER (Grade I) IN ZOOLOGY—The Secretary, The University, Edmund Street, Birmingham 3 (June 7).

RESEARCH ASSISTANT to work under the direction of the Professor of Surveying and Photogrammetry on a programme of research into Altimetry in its relation to Photogrammetry—The Secretary, University College, Gower Street, London, W.C.1 (June 10).

ASSISTANT TECHNICAL EXAMINING OFFICER (male) IN THE VICTUALLING DEPARTMENT of the Admiralty—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2166 (June 10).

UNIVERSITY LECTURER and a UNIVERSITY DEMONSTRATOR IN PHYSICAL CHEMISTRY—The Secretary of the Appointments Committee, Faculty of Physics and Chemistry, Chemical Laboratory, Cambridge (June 12).

ASSISTANT LECTURER (grade III) IN THE DEPARTMENT OF PSYCHOLOGY—The Registrar, The University, Liverpool (June 12).

ASSISTANT PRESS OFFICER (unestablished) at Headquarters of the Department of Scientific and Industrial Research, London—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting G.159/48 A (June 14).

SENIOR PRINCIPAL SCIENTIFIC OFFICER in the Royal Naval Scientific Service to undertake theoretical and experimental research in hydrodynamic problems—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2167 (June 14).

LECTURER IN MATHEMATICS in University College, Dundee—The Secretary, The University, St. Andrews (June 15).

SENIOR EXAMINERS (temporary) at the Ministry of Supply A.I.D. Test House, Haresfield, Middx.—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.344/48A (June 15).

SENIOR ENTOMOLOGIST-IN-CHARGE, an ENTOMOLOGIST, and a CHEMIST, in a Research Unit proceeding to Mauritius to undertake a large-scale mosquito eradication experiment using D.D.T. and B.H.C. insecticides—The Under-Secretary of State, Colonial Office (Research Department), Palace Chambers, Bridge Street, London, S.W.1 (June 21).

SENIOR SCIENTIFIC OFFICER IN THE DEPARTMENT OF PARASITOLOGY AND CHEMOTHERAPY, and a SCIENTIFIC OFFICER IN THE DEPARTMENT OF PHYSIOLOGY, CHEMISTRY, ANIMAL HUSBANDRY AND ANIMAL BREEDING, East African Veterinary Research Organisation, Kenya—The Under-Secretary of State, Colonial Office (Research Department), Palace Chambers, Bridge Street, London, S.W.1 (June 21).

LECTURER IN THE DEPARTMENT OF BOTANY—The Secretary, The University, Aberdeen (June 25).

CHAIR OF MINING—The Secretary, The University, Edmund Street, Birmingham 3 (July 1).

ASSISTANT and ASSOCIATE PROFESSORSHIPS IN THE DEPARTMENT OF PHYSICS—The Head, Department of Physics, University of British Columbia, Vancouver, B.C., Canada.

LECTURER, and a DEMONSTRATOR, IN THE DEPARTMENT OF BACTERIOLOGY AND IMMUNOLOGY—The Dean, London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

METEOROLOGICAL FORECASTERS in the West African Meteorological Service—The Director of Recruitment, Colonial Service, 15 Victoria Street, London, S.W.1.

CHIEF OFFICER OF THE OFFICIAL SEED TESTING STATION for England and Wales, and a SECOND ASSISTANT to the Chief Officer—The Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

PHOTOMICROGRAPHER (male) for senior appointment in technical grade—The Administrative Officer, National Institute for Medical Research, Hampstead, London, N.W.3.

ANALYTICAL CHEMISTS—The Director of Research, British Rubber Producers' Research Association, 48 Tewin Road, Welwyn Garden City, Herts.

ASSISTANT LECTURER IN AGRICULTURE, a DEMONSTRATOR IN POULTRY HUSBANDRY, an ASSISTANT LECTURER, and a SENIOR LABORATORY ASSISTANT, IN THE DEPARTMENT OF BOTANY—The Registrar, University College, Nottingham.

SOIL CHEMIST AND HEAD OF THE CHEMISTRY DEPARTMENT—The Bursar, Royal Agricultural College, Cirencester.

ASSISTANT ELECTRICAL ENGINEER IN THE PLANT ENGINEERING DIVISION—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1, endorsed 'Plant Engineering Division'.

INDUSTRIAL CHEMIST, and a CIVIL ENGINEER—The Staff Section, Ministry of Supply, Department of Atomic Energy, Risley, Warrington, Lancs.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Foreign Office. Tuberculosis in the British Zone of Germany, with a Section on Berlin. Report of an Inquiry made in September–October 1947. By Dr. M. Daniels. Pp. 32. (London: H.M. Stationery Office, 1948.) 6*d*. net. [83

Astronomical Navigation Tables. Vol. A: Latitudes 0°–4° North and South. (Air Publication 1618.) Prepared by H.M. Nautical Almanac Office on behalf of the Air Ministry. Pp. 233. (London: H.M. Stationery Office, n.d.) 7*s*. 6*d*. net. [113

British Standards Institution. Yearbook 1947. Pp. 324. (London: British Standards Institution, 1948.) 3*s*. 6*d*. [243

The Commandant's House at Margidunum. By Dr. Felix Oswald. Pp. 41 (17 plates). (Nottingham: University College, 1948.) 7*s*. 6*d*. [243

Notes on Descarte's Règles pour la direction de l'esprit. By S. M. Jacob. Pp. 36. (London: International Book Club, 1948.) 4*s*. 6*d*. [303

Colonial Office. Colonial Primary Products Committee Interim Report, January 1948. (Colonial No. 217.) Pp. 24. (London: H.M. Stationery Office, 1948.) 6*d*. net. [64

Electricity Supply: Directory of B.E.A., Boards and Officials. Pp. 52. (London: Electrical Review, Ltd., 1948.) 2*s*. net. [84

National Institute of Economic and Social Research. Occasional Papers, 12: The Measurement of Colonial National Incomes. By Phyllis Deane. Pp. xvi+173. (Cambridge: At the University Press, 1948.) 12*s*. 6*d*. net. [84

Department of Scientific and Industrial Research. The Fundamental Research Problems of Telecommunications. Reports of the Working Parties of the Telecommunications Research Committee. Pp. iv + 80. (London: H.M. Stationery Office, 1948.) 1*s*. 6*d*. net. [124

Memoirs of the Geological Survey of Great Britain: England and Wales. Dudley and Bridgnorth (one-inch Geological Sheet 167, New Series.) By T. H. Whitehead and Dr. R. W. Pocock. Pp. xi + 226 + 10 plates. (London: H.M. Stationery Office, 1947.) 7*s*. 6*d*. net. [124

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board, with the Report of the Director of Water Pollution Research, for the Year 1946. Pp. iv + 39. (London: H.M. Stationery Office, 1948.) 1*s*. net. [134

The Social Medicine of Old Age: Report of an Inquiry in Wolverhampton. By Dr. J. H. Sheldon. (Survey Committee on the Problems of Ageing and the Care of Old People: Medical Sub-Committee on the Causes and Results of Ageing.) (Published for the Trustees of the Nuffield Foundation.) Pp. x + 240. (London: Oxford University Press, 1948.) 5*s*. net. [144

The Case for the Full Development of Agriculture. By Jorian Jenks. Pp. 39. (Farnham: Rural Reconstruction Association, The Lime House, Tilford, 1948.) 1*s*. 6*d*. [144

Other Countries

Factors Regulating Blood Pressure. Transactions of the First Conference, April 24–25, 1947, New York. Edited by B. W. Zweifach and Ephraim Shorr. Pp. 175. (New York: Josiah Macy Jr. Foundation, 1947.) 1.90 dollars. [33

Conference on Liver Injury. Transactions of the Fifth Meeting, September 26–27, 1946, New York. Pp. 128. (New York: Josiah Macy Jr. Foundation, 1947.) 2.25 dollars. [33

Liver Injury. Transactions of the Sixth Conference, May 1 and 2, 1947, New York. Edited by F. W. Hoffbauer. Pp. 74. (New York: Josiah Macy Jr. Foundation, 1947.) 2 dollars. [33

Somaliland Protectorate. Report on General Survey of British Somaliland, 1946. (Colonial Development and Welfare Act, Economic Survey and Reconnaissance.) Pp. 20+12 plates. (Burao: Published under authority of British Military Administration, 1947.) 6*s*. [103

Science and Technology in China. (Published bi-monthly.) Vol. 1, No. 1, February. Pp. 16. (Nanking: Natural Science Society of China, National Central University, 1948.) [243

Communications on Applied Mathematics. (Issued quarterly by the Institute for Mathematics and Mechanics, New York University.) Vol. 1, No. 1, January. Pp. 100. (New York and London: Interscience Publishers, Inc., 1948.) 2.50 dollars; 8 dollars per year. [303

Los grupos sanguineos de los Indios del Ecuador: comunicacion definitiva. Por Prof. Dr. Antonio Santiana. Pp. 48+8 plates. (Quito: The Author, Facultad de Filosofia y Letras, Universidad, 1947.) [303

Memoirs of the Section of Studies on Alcohol, Laboratory of Applied Physiology, Yale University, No. 6: A Rorschach Study on the Psychological Characteristics of Alcoholics. By Dr. Charlotte Buhler and Prof. D. Welty Lefever. Pp. viii+64. (New Haven, Conn.: Hillhouse Press, 1948.) 75 cents. [303

India Digest. (Published monthly.) Vol. 1, No. 1, March. Pp. 112. (Ahmedabad: India Digest, 9 Cantonment, 1948.) 1 rupee; annual subscription, 12 rupees. [84

Caribbean Commission: Committee on Agriculture, Nutrition, Fisheries and Forestry of the Caribbean Research Council. Forest Research within the Caribbean Area. Pp. ix+128. n.p. The Sugar Industry of the Caribbean. (Crop Inquiry Series, No. 6.) Pp. xiii+343. 1 dollar. (Washington, D.C.: Caribbean Commission, 1947.) [84

Smithsonian Institution: Institute of Social Anthropology. Publication No. 6: Empire's Children—the People of Tzintzuntzan. By George M. Foster, assisted by Gabriel Ospina. Pp. v + 297 + 16 plates. (Washington, D.C.: Smithsonian Institution, 1948.) [124

Observatoire de Paris. Spectres, périodes et excentricités des binaires. Par Rose Bonnet. Pp. 290. (Paris: Observatoire de Paris, 1947.) [124

National Research Council. First Annual Report, Pacific Science Board, 1947. Pp. 50. (Washington, D.C.: National Research Council, 1948.) [154

Revista Medica de Valparaiso. (Publicacion trimestral.) Organo oficial de la Sociedad Medica de Valparaiso. Vol. 1, No. 1, Febrero 1948. Pp. 40. (Valparaiso: Sociedad Medica de Valparaiso, 1948.) Annual subscription, 100 dollars. [154

Report of the Twenty-fifth Meeting of the Australian and New Zealand Association for the Advancement of Science, Adelaide Meeting, August 1946. Pp. lxiv + 478. (Adelaide: Government Printer, 1947.) [224

R.C.A. Technical Papers (1947). Index, Vol. 2 (b). Pp. vi + 24 + ii. (Princeton, N.J.: Radio Corporation of America, 1948.) Free. [274

Government of Palestine: Board for Scientific and Industrial Research. Report of Activities, April 1945–March 1948. Prepared by the Executive Secretary, and Summaries of Research. Pp. 56. (Jerusalem: Board for Scientific and Industrial Research, 1948.) 150 mils: 3*s*. [274

Bulletin of the Museum of Comparative Zoology at Harvard College. Vol. 100, No. 1: Monograph of the Strophochellidae, a Neotropical Family of Terrestrial Mollusks. By Joseph C. Bequaert. Pp. 210 + 32 plates. (Cambridge, Mass.: Harvard College, 1948.) [274

Herbertia. Vol. 13: Narcissus edition. Edited by Hamilton P. Traub. Pp. 186. 3.50 dollars. Vol. 14: 2nd Daylily edition. Edited by Hamilton P. Traub and Harold N. Moldenske. Pp. 204. 3.50 dollars. (Stanford, Calif.: American Plant Life Society, 1946–1947.) [274

Catalogue

Astronomical Instruments. (Publication No. 14.) Pp. 44. Mirrors and Lenses. (Publication No. 16.) Pp. 4. (Newcastle-upon-Tyne: Sir Howard Grubb, Parsons and Co., 1948.)